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July 10, 1926

United Verde Coyote Blast Breaks 105,000 Cu. Yd.

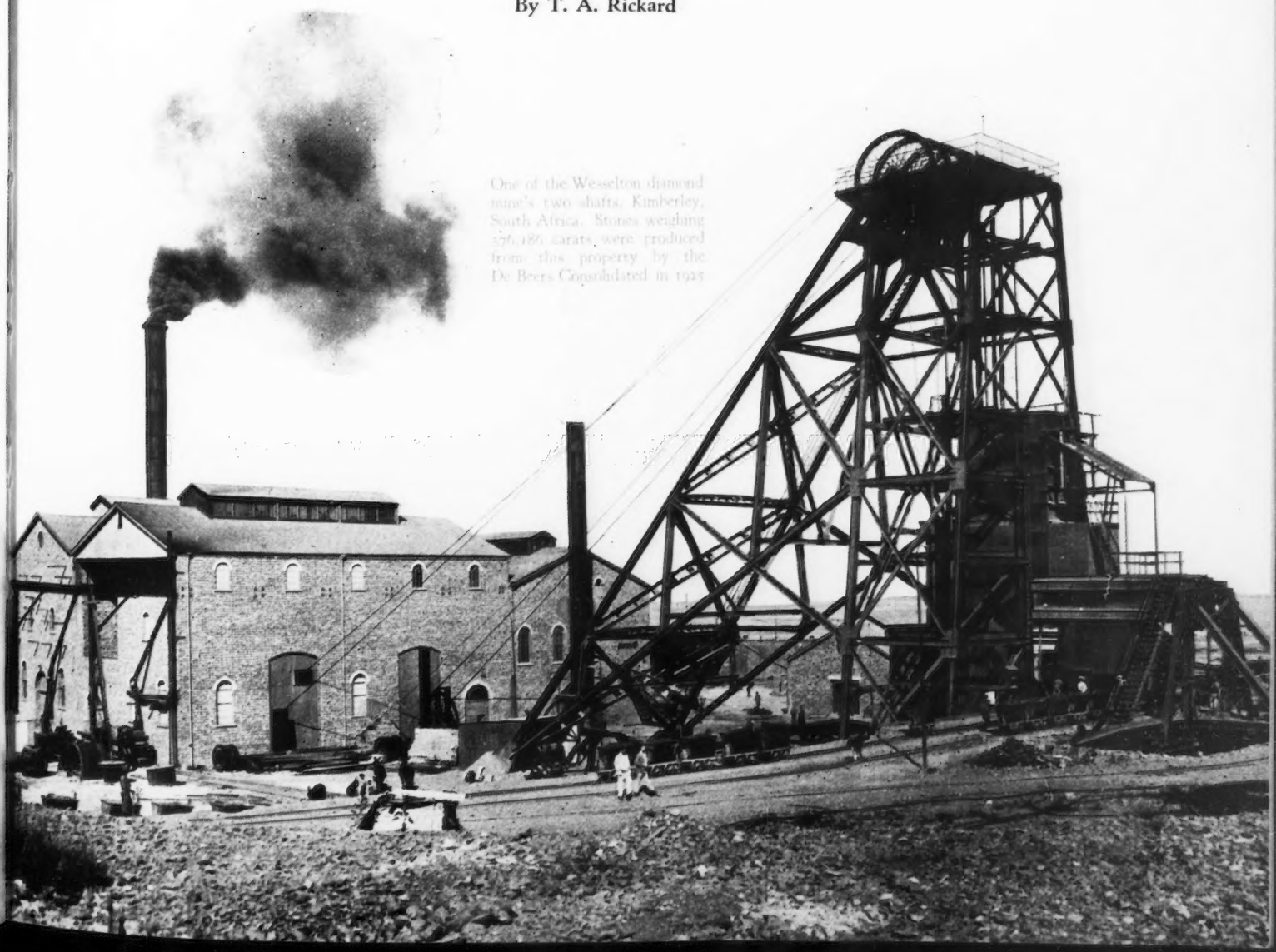
By E. M. J. Alenius

How to Build a Steel Frame for a Mine Model

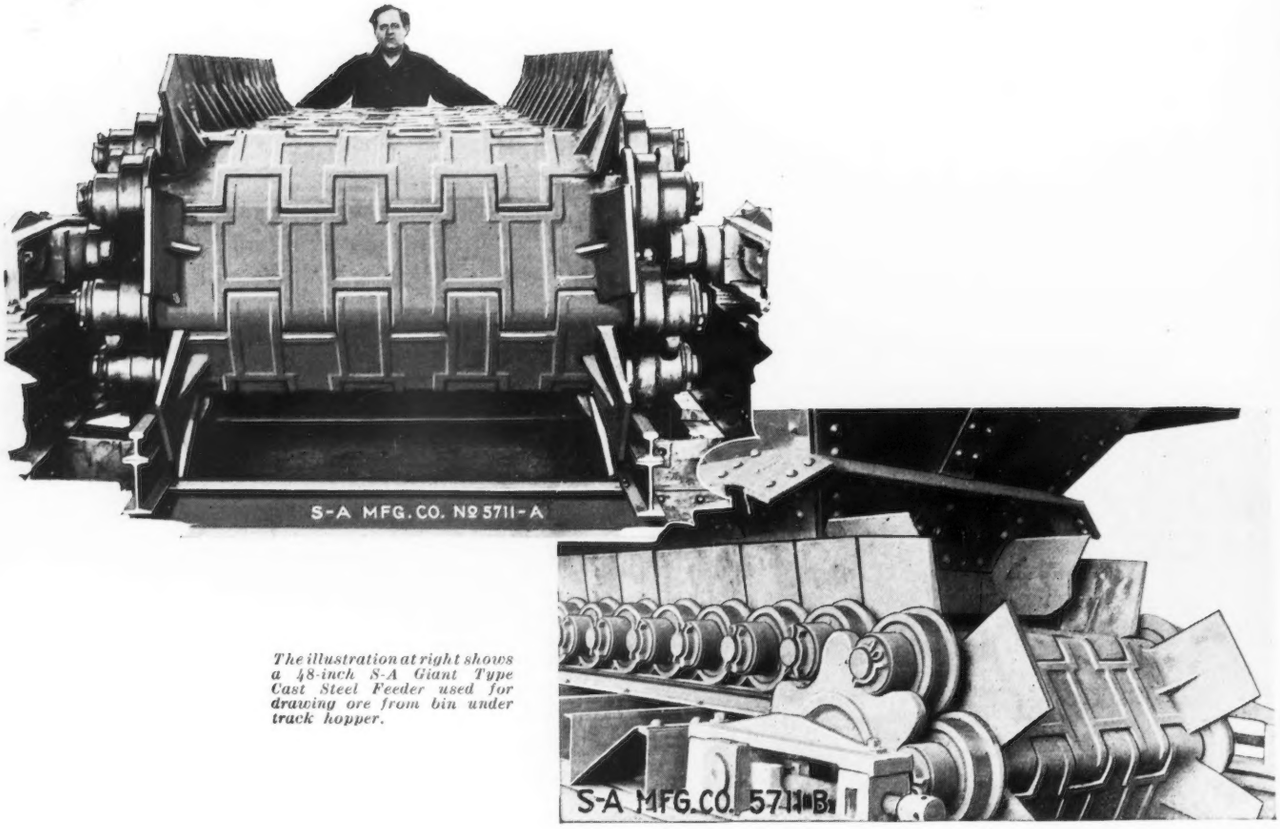
By Cleveland O. Moss

Ancient and Primitive Mining and Metallurgical Methods—I

By T. A. Rickard



One of the Wesselton diamond mine's two shafts, Kimberley, South Africa. Stones weighing 576,186 carats were produced from this property by the De Beers Consolidated in 1925



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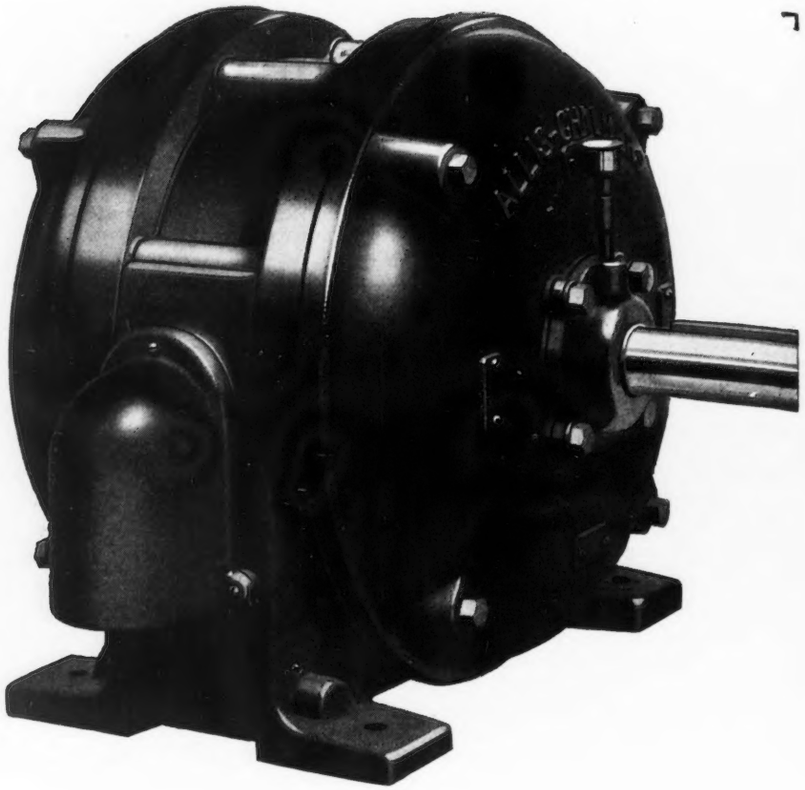

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ENGINEERING AND
MINING JOURNAL

JOSIAH EDWARD SPURR, Editor

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Mining Expansion

SENATOR CAMERON, of Arizona, does not like the somewhat critical remarks which *Engineering and Mining Journal* made concerning his copper tariff speech a few weeks ago, and devotes several pages of the *Congressional Record* to a rebuttal. The analysis of this will not be gone into now, though perhaps it will be done later. Many things which he states therein are true; but concerning them a different interpretation might be presented. What we would like to comment on at the moment is his statement that *Engineering and Mining Journal* is international. He makes it as an accusation, instancing our international circulation; and he regards this as an abhorrent quality, stating that it is about the same as bolshevism or communism. To the latter we would not agree. In fact our uncompromising attitude toward Russia lost us an indignant subscriber only last week. We were sorry to lose him, for we always feel friendly toward indignant subscribers. But we are glad that Senator Cameron pointed out our international circulation and outlook.

In becoming international, as we are doing more and more, we are following the flag—not the political standard, but the business banners of America—especially the great expansion of American mining—all over the world. The mining business and interests of England always have been world-wide; due to our great natural resources, and our home consumption, that of the United States was long nearly self-contained. Time has changed and is changing this; our mineral supplies have been noticeably sapped, though our mining industry is still vigorous, while our great industrial expansion has entailed an immense increase in consumption, to which we can see no limits. Our mining companies in many cases have met this situation by investments in mines outside the United States—enormous investments of American capital and of American personnel—engineers and executives—in Canada, Mexico, and Central America, in South America, Europe, Asia, and Africa. American mining industry has become international and is growing more and more so. *Engineering and Mining Journal* follows wherever American enterprise goes. Moreover, the American industrial spirit toward the rest of the world is not provocative, selfish, and trouble-breeding: it is helpful and co-operative, since this is good business sense as well as Christian ethics. It makes international alliances. The diplomacy of American mining men is of ambassadorial value in Asia Minor, Mexico, Poland and Germany, in Belgium and South America. As the world becomes more and more upon a basis of economic partnership and mutual business advantage, so-called political differences and so-called racial animosities will dwindle and cease to be troublesome. The best American and the best Mexican or Belgian are those who understand this; and the expansion of American mining abroad and the making of advantageous economic arrangements with mining men of other nations are to the best interests of the United States, including Arizona. That there are dangers in this, there is no dispute; we have pointed them out and will point them out again. World economic combinations and consortiums may arise which will have to be regulated by the League of Nations or by the World Court, in response to the demand of the great new world influence, Public Opinion. The industrial co-ordination of the world's resources and business is running ahead of governmental co-ordination. Nevertheless, the principle of international industrial expansion and co-operation is sound.

As for a copper tariff, we have long ago pointed out that if the copper industry wanted it or shall want it, it can have it. The tariff law of 1922 refused nobody a tariff who wanted one. But even in Arizona Mr. James Douglas is recently quoted in print as having stated (truly) that the copper industry can attend to its own affairs, and does not need help from "meddling politicians." We must conclude that the American copper industry as a whole does not want a tariff, and we can readily understand why—namely, the great and increasing international mining and international marketing done by the copper industry. Besides the nuisance which they feel it would be, they probably fear retaliatory tariffs, which are easy: it is a game that two or more can play at. The business and industry of the little countries of Europe are so shackled by tariff walls about one another that economists are agreed that these artificial barriers must in general be lowered or broken before real prosperity and peace can return.

The Panama Corporation, Ltd.

WHEN IT BECAME KNOWN in New York and Washington that large mining concessions in Panama had been granted to an English corporation the United States Senate immediately became active and called on the Secretary of State to determine to what extent the British Government was interested. It seems that these concessions were granted to individuals, who in turn formed the Panama Corporation. Stock of this corporation was placed on the London market and oversubscribed before American investors were aware of its issue. Secrecy surrounded the entire transaction from the time the engineers entered the field, and even after the concessions were obtained but little information was given to the public. Hence, the commotion when the news reached Washington.

The Secretary of State has secured copies of the original contract, and he says, "No concessions involving control over the public land and natural resources of the Republic of Panama have been secured by the

British Government in that republic." The grants were made "to a Mr. J. J. Calderwood, a British mining engineer, who has been prospecting in Panama on behalf of an unincorporated group of British mining men." The concessions referred to are "an exclusive right of exploration for ten years" with the further right "to acquire a perpetual title to such mines as may be discovered." It is apparently patterned after the British South Africa Co., Ltd., or the Rhodesian-Congo Border Concessions, Ltd. The latter has a concession embracing 52,000 square miles in Northern Rhodesia. Mr. Walter Broadbridge, of London, is a director in both the Rhodesian-Congo and the Panama Corporation; hence the inference of the similarity of the two concessions.

The contract specifically calls for metal mines, as salt, petroleum, coal, and mineral waters are exempted in Art. 4. Rights to mines acquired prior to date of this contract are not affected. The concessionaire pays no taxes for a period of ten years, but as a compensation to the government for benefits received he pays the government 2 per cent of the gross profits received from the sale of gold, payments to begin one year after exploitation begins.

Article 18 of the contract relating to the transfer of the property, or an interest therein, safeguards both Panama and the Monroe Doctrine, in which "an exception is made in case the cession or transfer is desired in favor of a foreign government, which can by no means take place." Further "if the successor be a foreigner" he agrees "not to make use of diplomatic intervention in any form, and that he will confine himself to defending his rights before the tribunals of the Republic of Panama."

No agricultural rights are included, and, as for timber, the concession carries the provision that the concessionaire may use such timber as is needed for mine operations. Water rights "for the general operation of the enterprise" are granted. There seems, therefore, no cause for worry regarding these concessions as an international affair. A few men have seen the opportunity to secure control of an area of latent mining possibilities and acted accordingly.

Mr. Smith of Boston

SOMEWHAT OVER TWO YEARS AGO the Kingdom of Hungary, bankrupt and in political and economic confusion, applied to the League of Nations for a receivership. The financial and economic adviser of the League framed a plan similar in its essentials to the Dawes plan which was applied to Germany, including the rehabilitation of the currency, courageous taxation, realization on nation-owned assets, the establishment of a sound central bank, and the floating of a foreign loan with the prestige of the League behind it; and added the turning over of the finances of the country to a practical economic dictator, called Commissioner General. To the post of Commissioner General was called Jeremiah Smith, a lawyer of Boston, of the firm of Herrick, Smith, Donald & Farley, whose record in "Who's Who" and elsewhere showed no other claim to fame except that he had served as Captain in the Quartermaster's Corps, and during the peace conference acted as one of the financial advisers to the American delegation. The other day he terminated his work in Hungary. The nation had become sound and prosperous. The bonds of the foreign loan crossed par last week. Finances, economics, and business were completely stabilized; and social and political unrest was correspondingly quieted. On leaving he was handed his two years' salary, fixed by the League two years ago, at $50,000 a year—but declined to receive it. When urged by the Hungarian treasury head that the check had been drawn and could not be cancelled, he donated it as a gift to the people of Hungary from the people of America. Decorations, the usual courtesies of foreign countries to those they desire to honor, he had already declined.

Doubtless Mr. Smith of Boston will return to practice law as a member of the firm of Herrick, Smith, Donald & Farley. We hope so. It is heartening to know that American citizens can step from the ranks and perform such a work of skill, tact, and honesty, saving a whole nation from distress, and then go back, figuratively speaking, to the plow. It is the feeling that America has many plain citizens of that type that inspires a confidence in its future, both internally and in its growing contacts with the rest of the world.

Coeur d'Alene to Have an Electrolytic Zinc Plant

AFTER TWO YEARS of uncertainty the Coeur d'Alene district, in Idaho, is definitely assured of an electrolytic zinc plant of its own. On June 17 formal announcement of the immediate construction at Kellogg of an initial unit of fifty tons' capacity was made by Stanly A. Easton and James F. McCarthy, in behalf of the Sullivan Mining Co. The Sullivan company is owned half-and-half by the Bunker Hill & Sullivan Mining & Concentrating Co., of which Mr. Easton is manager, and the Hecla Mining Co., managed by Mr. McCarthy. It operates the Star mine, famous, among other things, as the bone of contention in a bitter legal battle, and as the theater for the driving of the long Star crosscut from the 2,000 level of the Hecla mine, through the shaft of which it is operated. The Star will be the principal source of ore for the new plant; but also it will be in the market for concentrate to be treated on a custom basis.

The delay in the decision to build the plant was occasioned by a number of factors. In the first place it was necessary to develop the Star orebody to a sufficient extent to be reasonably assured of an adequate supply of concentrate. This stage was reached many months ago, and subsequent work has added largely to the developed ore. The crosscut is 4,000 ft. below the apex of the Star vein, and, judging from the formation in the adjoining Morning mine of the Federal Mining & Smelting Co., the question of ore reserves is not one to cause apprehension.

A second cause for delay was the competition offered by the Anaconda Copper Mining Co. Anaconda was anxious to get Coeur d'Alene zinc concentrate for treatment at its big electrolytic plant at Great Falls. There are virtually no limits to the capacity to which this plant can be increased, and Anaconda hoped to dominate the zinc industry in the Rocky Mountain states.

Naturally it did not look with favor on the erection of even a small competing plant, and went as far as it possibly could in offering the Sullivan Mining Co. favorable terms to ship its concentrate to Great Falls, as is done by the Federal company with its Morning concentrate. Not only was the Sullivan concentrate involved, but also the production and possible production of a number of smaller zinc-mining properties, for which a plant in the Coeur d'Alene might offer a favorable market. Apparently, however, Anaconda's best bid was not good enough.

Still another matter that required adjustment was the basis of participation of the two holding companies in the zinc-plant project. The Bunker Hill owns and operates the concentrator in which the Star ore is handled by flotation; but the determination of an equitable basis on which to compensate the Bunker Hill for the subsequent electrolytic treatment, if it alone should build and operate that unit, was extremely difficult. Apparently this question has been settled—or rather avoided—by an arrangement whereby the two companies jointly finance the construction of the electrolytic plant, and presumably will be partners in the operation of it.

The design of the new plant has been made by U. C. Tainton and the metallurgical staff of the Bunker Hill company. Mr. Tainton was the pioneer in many of the latest developments in electrolytic technique: he has been an advocate of the use of high acid solutions, of high current density, of mechanical agitators, and of other procedures that have been adopted generally in the last few years. Doubtless the new plant will incorporate the very best and latest methods and equipment, benefiting not only from the work in the pilot plant at Kellogg but from the results obtained in practice at Trail, in British Columbia, and at Great Falls. In view of the rapid advance in the art, it should be a definite advantage to build from the beginning, with the accumulated knowledge of several years as a guide. A remarkable efficient plant should be the result.

The decision to proceed with construction marks another step in progress in hydrometallurgy and in the beneficiation of the so-called complex ores. That wet methods of metallurgical treatment usually have distinct advantages over fire methods goes without saying. They are more delicate, more intricate, of course; but they produce more pure metal and they leave less in the residue. The ingenuity of metallurgists is gradually devising ways for solving the mechanical problems of handling hot and acid solutions economically, for controlling electrolytic precipitation accurately, and for overcoming a dozen difficulties that have added to the cost. Truly the era of hydrometallurgy is upon us.

Petroleum and Statesmen

SO FAR THIS YEAR petroleum producers have reason to be optimistic. No Smackover or other bonanza pool has made its unkind appearance to spoil their calculations, and the production of crude for the first six months has been almost 6 per cent less than for the corresponding period in 1925. Curious is the situation that exists in the petroleum industry, where new production is eagerly sought, fought for, and at the same time dreaded. Of Alcibiades and his fellow citizens it was said that they loved him, they hated him, they could not do without him. Producers could indeed do with a little less petroleum—its absence would make the market stronger and perhaps the heart grow fonder, so the analogy between the Greek statesman and a barrel of oil, however permissible or unpardonable it may be in kind, is not entirely accurate. It might be remarked, by way of defence in passing, that statesmen and ex-statesmen are very apt to be mixed up with oil, and Mr. Hughes' recent analysis of the petroleum situation is a case in point.

At any rate, the production of crude in the first half year just closed was approximately 355,000,000 bbl., and if the same amount is produced in the next six months the year's output will be some 50,000,000 bbl. less than in 1925. Should the decline continue throughout the second half the production would be considerably less. Even at that it will be huge and furnish food for thought.

Mr. Hughes' analysis of the petroleum situation with regard to suggested measures of conservation, which has been referred to, hardly disposes of the matter. In fact he leaves the problem of conservation just where it was before he started. The former Secretary contends that Congress has no power under the Constitution to control oil production within a state, except on Indian lands; that oil production is not interstate commerce, and that therefore everyone might just as well go home. Mr. Hughes simply says, in other words, that the problem of working out some means of conserving oil is a very difficult one to solve. The problem still remains. Blind faith, moreover, that the future will by some means or other provide us with abundant oil or something just as good is hardly an excuse for blind waste of the petroleum resources of today.

Hard Hats and Conservatism

THE USE OF "HARD HATS" in underground operations has been advocated from time to time, with the result that this safety aid is at least known throughout the industry. About six years ago an enterprising manufacturer perfected a light type of hard hat and has since supplied it to the mines. In the last five years, it is stated, about 15,000 hats of this sort have been marketed. It has been further learned that recently this manufacturer has moved into larger quarters and increased his manufacturing facilities to keep pace with the demand, which has doubled within the present year. This is no doubt due in part to a keener appreciation of the causes of mine accidents and the safety precautions needed to reduce them to a minimum. Protection from falling rocks and against accidents to the eye are afforded by the hard hat of approved shape.

The prevalence of coal-mine explosions, with their attendant fatalities, has been more or less featured in the newspapers and has had no doubt a considerable influence in quickening the work of accident prevention in both coal and metal mines. The conservatism of the metal miner is shown in the relatively slow adoption of the hard hat, but as conditions changed and the economic significance of accident prevention grew apparent, the metal miner became alive to the advantages of this protection for the head and is now apparently making a greater use of it. The increased demand is coming from Arizona, Michigan, and the East.

United Verde Coyote Blast No. 4 Breaks 105,000 Cu. Yd.

Explosives Used, 103,350 Lb.—Six Months Required to Prepare Charge—Four Days to Place Powder—Overburden 155 Ft. High

By E. M. J. Alenius
Chief Engineer, United Verde Copper Co.'s Steam Shovel Mine, Jerome, Ariz.

COYOTE-HOLE BLASTING has been conducted at the Steam Shovel mine of the United Verde Copper Co. since the fall of 1924. This method of blasting was decided upon after unsuccessful attempts had been made to break the high banks by means of machine-drilled holes. A bank 320 ft. high resulted in the west end of the pit on the 160 level when the upper levels were consolidated with the lower level. All blasting has been done in the waste material which is being stripped above the United Verde orebody.

To date four coyote blasts have been undertaken, all of which have met with varied degrees of success. The

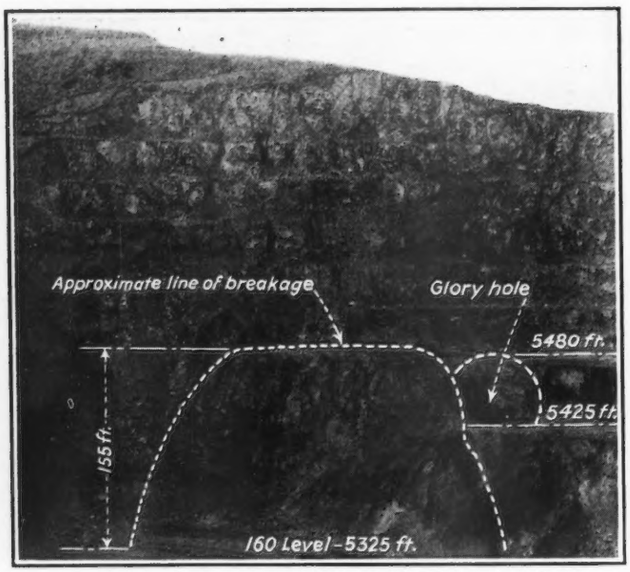

Fig. 1—Bank on day previous to blast

first large blast was set off on Dec. 8, 1924, under the supervision of the late J. D. Cushing. One hundred thousand pounds of black powder primed with 13,050 lb. of 50 per cent gelatin was used to break down 140,000 cu.yd. of material. On March 10, 1925, a second blast was fired. This time 135,000 cu.yd. of rock was broken by 95,400 lb. of black powder used with 3,500 lb. of 50 per cent gelatin. The third blast was the largest undertaken, and will remain such, as stripping operations are rapidly nearing completion. The third coyote was loaded with 250,000 lb. of black powder and 9,900 lb. of 50 per cent gelatin. It was estimated that 260,000 cu.yd. of waste was loosened by this blast, which was shot on Aug. 11, 1925.

The methods used in carrying out the first three blasts were all similar. A drift was started in the face of the bank, and when sufficient depth had been obtained the drift was run parallel to the bank. The depth of toe was varied from 66 to 127 ft. in the first three blasts. However, in the third coyote hole the drift was run along the pit limit, and not exactly parallel to the face. Pockets for holding the charges were sunk at even intervals in the bottom of the drift or in offsets, 11 to 20 ft. deep. The charges were fired instantaneously by four No. 8 blasting caps placed in each pocket. Double-countered cordeau was strung through the drift connecting all the charges as an added precaution against misfire. After the pockets were loaded, the coyote workings were carefully backfilled with loose rock.

As the material from the third blast was being removed, ample time was available to completely study the conditions affecting this method of blasting. Though the first three blasts were fairly successful, certain results were noted which demanded improvement. In the first place, portions of the bank were more easily broken than others, this being caused by a difference in the structure of the waste rock. Though the waste material of the Steam Shovel mine is mainly a dense augite-diorite, certain areas have become weathered and break up readily with a slight disturbance. The unweathered portions are very hard and tough, and were not satisfactorily broken by black powder. In several sections the bank seemed to be undercut, so that the desired back break was not obtained. This condition resulted to some extent on account of the great height of the bank. As the broken rock was removed from the third blast, it became apparent that the rock had not been sufficiently shattered in front of the pocket. This was caused by too great a depth of toe on the pocket. A great disadvantage resulted from running the coyote drift in from the working face of the bank, as it was necessary to clean up the bank thoroughly before a solid face could be obtained. Moreover, during the progress of the work for the third blast, caves on two occasions completely buried the working entrance, causing serious delays.

All these factors were carefully considered in preparing for the fourth blast. The coyote drifting was done from behind the face by utilizing an old adit from No. 3 shaft. The area to be blasted was carefully selected, and all pockets were placed in the hardest rock with a uniform structure. The height of bank and depth of toe were substantially decreased. Finally, an explosive (Quarry Special No. 6, manufactured by the Apache Powder Co.) was selected which, while giving a similar propulsive effect, has about twice the shattering effect of black powder.

Preparation for Blast

The preparations for the fourth blast were quite extensive. A total of 828 ft. of drifting was completed, 65 ft. of which was a connection between the 160 adit and No. 3 shaft station. The drift was cut 4 x 6 ft., and was run around a portion of the fire country, and consequently the working face was quite hot at times. An electric fan was placed in the shaft station and air forced through an 11-in. pipe. Two Coppus Vano blowers were placed in the line as boosters when the drift progressed. The drift was supplied with a

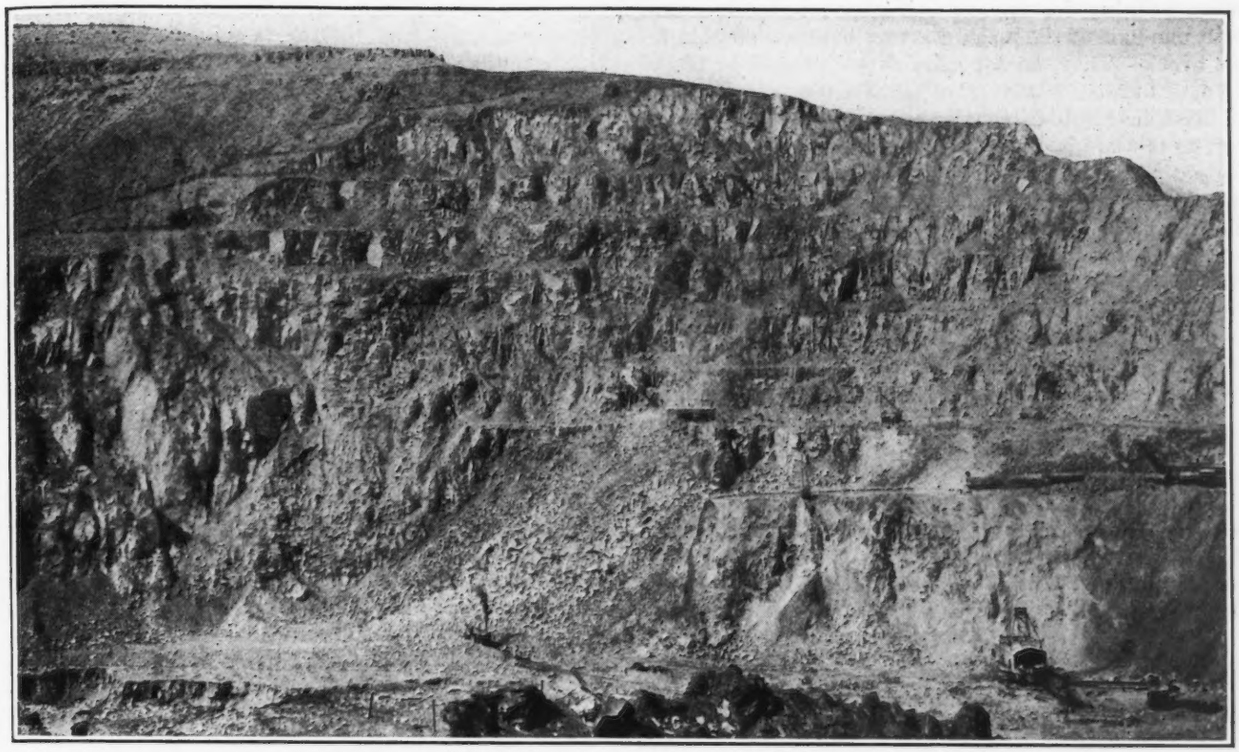

Fig. 2—Bank on day following blast, with shovel cutting through toe for loading track

1-in. water line and a 2-in. air line. Pockets were cut 5 x 5 ft. and sunk 13 to 20 ft., depending on the estimated toe. The total amount of sinking amounted to 160 ft. With a varying crew of from four to ten men, six months' time was required to complete the preparatory work for this blast.

It may be noted on the map that the portion to be blasted lay in a corner between the stripping limit and the quartz-diorite contact. As the crosscuts approached the fire country toward the quartz, the rock temperature increased, so that when a rock temperature of 120 deg. F. was reached the work was stopped. In the first coyote blast, one pocket lying close to the fire area had a maximum rock temperature of 156 deg. F. This pocket was lined on the bottom and sides with one-inch coating of gunite. Black powder can be used at higher temperatures than other powders. As a different powder was being used in the fourth blast, precautions were taken not to expose it to a greater temperature than 120 deg. F.

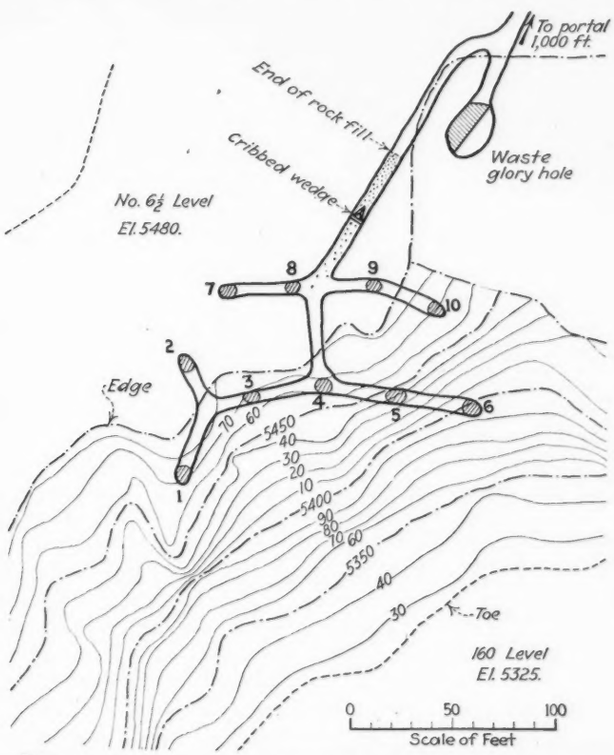

Fig. 3—Plan of coyote blast No. 4, showing location of the ten pockets

The powder selected for the fourth blast was "Quarry Special No. 6," which had the following composition: Nitroglycerine, 4½ per cent; mixture of TNT and DNT, ½; $NaNO_3$, 66; sulphur, 14; powdered coal, 14; and $CaCO_3$ (chalk), 1 per cent.

In manufacturing this powder the last four ingredients are carefully screened and mixed. The solids are then coated with the mixture of nitroglycerine, TNT, and DNT in liquid form, so that each particle has its individual detonating agent. Compared with TNT this powder has 70 per cent of the ballistic pendulum rating. It gives a lead block test of 3 mm. depression. The sensitiveness is rated as 7 in. between half sticks. The powder is free running and comes packed in 2½-lb. bags, four bags to a case.

In calculating the total powder necessary for the blast, the amount of QS No. 6 to be used was considered as being from 0.85 to 0.900 of the amount of black powder had it been used. From a study of previous coyote blasts, a factor of from 2 to 2.10 lb. of explosives (chiefly black powder) per cubic yard of burden was found to break the rock satisfactorily. The yardage used in making the calculations is only that in front of a vertical plane through the rear of the pockets, al-

lowing nothing for any probable back break and only about one-half of the mean distance between pockets for side break. Thus, on a preliminary estimate of 50,000 cu.yd. of burden, 90,000 lb. of QS No. 6 was ordered for the blast, or 1.8 lb. of powder for each cubic yard. However, as it was impossible to clean the bank as had been originally planned, and the burden before the blast amounted to about 60,000 cu.yd., sufficient 50 per cent gelatin and QS No. 1 was added to bring the total amount of explosive used equal to 1.72 lb. per cubic yard. This factor, though lower than the former, was considered sufficient on account of the greater strength of the other explosives.

In distributing the several charges, each pocket received approximately an amount of powder proportional to the amount of the work to be done. Theoretically, each pocket had to move that ground in front of it through a certain distance. This distance may be considered as the resultant of the horizontal distance from the pocket to the toe, and the vertical distance above the pocket. The total burden was divided among the various pockets, depending on the manner in which the ground was expected to break.

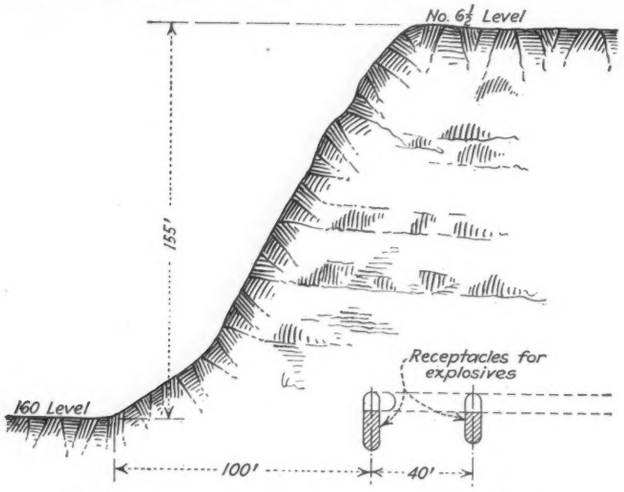

Fig. 4—Section through bank before blasting

A table showing the overburden to be broken and the charge for each pocket follows:

Overburden and Charge for Each Pocket

Pocket Number	Distance to Break Horizontal	Distance to Break Vertical	Cubic Yards in Each Pocket	Amt. of Powder (50 Lb. Cases) QS No. 6	Amt. of Powder (50 Lb. Cases) 50 Per Cent Gelatin	Amt. of Powder (50 Lb. Cases) QS No. 1
1	99	160	8,360	250	18	..
2	30	167	7,000	216	48	20
3	108	150	7,700	232	16	..
4	98	146	6,220	186	13	..
5	82	125	3,640	108	8	..
6	68	80	2,220	68	5	..
7	42	158	7,720	232	50	14
8	41	158	6,560	214	43	..
9	44	162	7,440	200	26	..
10	38	152	3,130	94	6	..
Tota			59,990	1,800	233	34

In priming the pockets a large amount of 50 per cent gelatin was used to insure a rapid detonation, which was greatly desired because of the increased shattering effect. It may be noted that in the rear pockets, Nos. 2, 7 and 8, the amount of 50 per cent gelatin used was about 20 per cent of the amount of QS No. 6 used. In priming these pockets it was hoped that the increased rate of detonation would result in a greater upward action before the front pockets would break through the toe. Thus, a greater back break might be obtained. This assumption appears to have been well founded, as

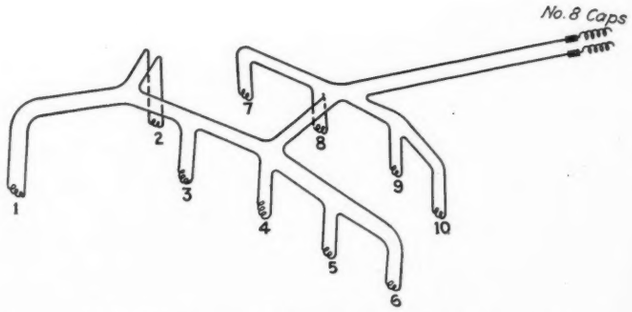

Fig. 5—Wiring diagram for firing charge

the ground was broken as far as 60 ft. behind the rear row of pockets on the 6½ level, giving a back slope of 1 to 3.

As soon as the drifting work was completed, the pockets were wired and cordeau was run between them. In the pocket proper both cordeau and the No. 8 insulated copper wire were covered with discarded rubber air hose and placed in a wooden conduit 2 x 2 in., inside dimensions. The conduits were carried up to the back of the drift. Wire and cordeau were protected in the main drift only by the old rubber hose, and suspended from plugs in the back as far as the backfilling extended. Diagrams of the wiring and the manner of running the cordeau are shown in Figs. 5 and 6.

Four Days Required to Place Explosives

The work of loading the powder was extended over a period of four days, the hot pockets being loaded on the fourth day. The detonator was furnished by four No. 8 blasting caps in each pocket inclosed in one case of dynamite. Each pocket was capped out separately and the resistance of the circuit noted each time on a blasting type ohmmeter-galvanometer. Each day the powder was unloaded from the box car brought up to the portal of the drift. Here the cases were opened. Dynamite for priming the charges was sent in first in the cases and lowered into the pocket in a canvas bag. The Quarry Special powder was emptied from the cases on the outside, and the bags were placed in the cars. The bags were cut and dropped into the pocket. Four special trucks were constructed with a wooden body for transporting the powder.

While one car was being loaded, another was being unloaded at the pocket and two cars were passing at the station. The total loading time was 22½ hours, for an

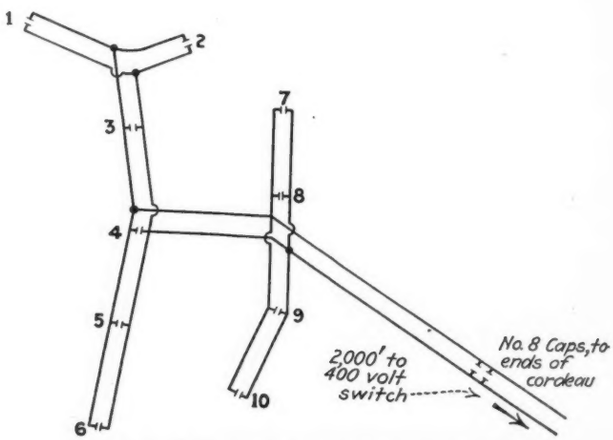

Fig. 6—Diagram showing cordeau circuit

average tram of 1,100 ft. A crew of ten men handled the powder on the outside; four men were used inside unloading and eight men were used tramming, making a total crew of twenty-two men.

As soon as the powder had been loaded, backfilling started, the remaining depth of the pockets being first filled. A total of 956 12-cu.ft. cars of rock was used in backfilling, requiring 145½ hours for an average tram of 200 ft. Three shifts of fifteen men each were used after the loading was completed. Four men were placed at the waste hole loading the cars. Four men also were at the face shoveling the muck back, and six men did the tramming. Backfilling was continued for a distance of 50 ft. back of the rear crosscut, to a point about opposite the waste glory hole, Fig. 3. A crib wedge of 10 x 10 in. timbers was placed and rocked in about 25 ft. back of the rear crosscut. This wedge acted as a further protection to prevent the backfill from blowing out. The lower portion of the wall where the backfill ended was found to be intact after the blast. The upper portion had been shaken down, and the rock thrown for a distance of about ten feet.

Fig. 7—Workmen loading powder for blast

The strictest safety precautions were observed at all times. During the loading the tracks were kept wet, and the men working inside were supplied with rubber shoes. Electric lights on a 110-volt circuit were placed in the drift between the portal and the shaft station. Portable electric lanterns were used elsewhere. However, during the backfilling open lights were allowed. All explosives were kept carefully covered. The resistance of the blasting circuit was checked every twenty minutes, the circuit being grounded at other times. Two blasting type ohmmeter-galvanometers placed near the waste glory hole were used for the testing. In case of a broken or shorted wire during the backfilling it would have been possible to locate the source immediately and remedy the condition. A bulkhead was placed over No. 3 shaft to protect the underground workings. At the time of firing the shot, no men were allowed underground. One week elapsed from the beginning of the loading until the shot was fired. No. 8 wire was carried outside and connected to the 440-volt main-line switch. When the shot was set off, the ground rose and settled again. No loud report was heard. The broken rock was not scattered, the farthest particle being thrown less than 175 ft. from the original toe. Several large rocks were left on the top of the muck pile. At present it appears that the bottom of the pile is very well broken up, the larger pieces being on the surface only.

A total of 105,000 cu.yd. of rock was broken by this blast. It is probable that more rock was broken, as the bank has since been caving in several places. On a basis of 105,000 cu.yd. of rock broken, a factor of 1.167 cu.yd. of rock was broken per pound of QS No. 6 used, or 1.016 cu.yd. broken per pound of total explosives used.

The planning, loading, and firing of this blast was completely supervised by J. C. Perkins, superintendent of the Steam Shovel mine. No outside assistance was called in at any time, all details of the work being carried out by the force of the United Verde Copper Co. Several more coyote blasts are being planned. It is the intention to make use of the same drift, and crosscut parallel to the rear drift of Coyote No. 4. Thus it will be possible to prepare for the coyote blasts in advance, insuring an adequate supply of broken rock.

General Motors Adopts Chromium Plating

After extensive experiment in the last two years, the General Motors Corporation has adopted chromium plating as a substitute, commercially, for nickel plating, says *Iron Age Review* of May 6 in the course of an article on this subject. Chromium has been known as a plating medium for some time, but the processes have been expensive. It was to overcome this disadvantage that the corporation named has been experimenting at Detroit.

On March 22, the first radiator shells for public use were produced at the Olds plant, and at present production is running about 310 a day. All Oldsmobile cars now have chromium plated radiators, and other exterior parts formerly nickeled are being plated with chromium as rapidly as factory changes can be made. These parts include lamp shells, bumpers, crank-hole caps, motormeters, and hub caps. Other subsidiaries of the General Motors may use the process.

The new method is purely a plating process, there being no infusion or change of the original surface. Iron and steel objects are first given a coat of copper, and then nickeled, in accordance with the usual process. The cost heretofore of heavy nickel plating has been approximately 46c. per square foot. The entire cost of chromium plating is approximately 50c. a surface foot at present, and it is believed this cost can be reduced somewhat.

Even where it is necessary first to nickel the parts, there is little difference in cost. This is for the reason that the copper buff, which was required before nickel plating, is eliminated and the saving in labor cost equalizes the additional cost of the chromium plate.

The extreme hardness of the plate is leading the corporation to continue its experiments. Experiments are being conducted with the movable parts of the motor-car engine, such as the crankshaft, valves, and tappets, which have been chromium plated to determine the wearing qualities of the material.

Checking Bullion Against Ore Assay

In the article "Checking Bullion Against the Ore Assay," which was published in the May 15 issue, the following formula

$$(A \times B) + (C \times D) = E - (F \times G) - (H \times I) - J$$

should read

$$(A \times B) + (C \times D) = E + (F \times G) + (H \times I) + J$$

The minus signs are contradictory to the text itself, according to the author.

Notes on Ancient and Primitive Mining and Metallurgical Methods—I

Early Placers—The Oil on the Golden Fleece—Refining as Described by Various Writers—Pliny on Working Alluvial Deposits and Veins—Hannibal's Profitable Silver Venture in Spain

By T. A. Rickard

IT IS INTERESTING to trace the discovery of technical processes and the development of mining and metallurgical practices among the ancients; such a study illustrates the working of the human mind and the evolution of ideas.

Mining antedates metallurgy, because the first metals were gathered in their native, or elemental, state, so that they needed no preparatory treatment before being hammered into shape. All that primitive man had to do was to pick up bits of yellow gold or ruddy copper, as a child picks up a pretty stone. Gold was easier to find in those far-off days than it is today after centuries of gleaning; it was the product of erosion and of natural concentration in the streams and torrents along which primitive man wandered in search of game. Strabo tells us that in the country of the Saones, who occupied the heights of the Caucasus, "the winter torrents are said to bring down even gold, which the barbarians collect in troughs pierced with holes and lined with fleeces; hence the fable of the Golden Fleece." In the land of the Saones was Colchis, now named Migrelia, which was at the mouth of the Phasis, a stream now known as the Fasch.

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The story of Jason and the Golden Fleece represents the beginning of Greek enterprise overseas in Asia Minor; it is also a poetic expression of an early mining adventure. According to the classic myth, Jason and his comrades sailed on the ship "Argo" from Thessaly in quest of the Golden Fleece, which was in Colchis. The king of that country consented to yield the precious fleece if Jason performed sundry prodigies, which would have been beyond his strength had not Medea, the king's daughter, a typical wise woman or witch, given him a charm that helped him in his hour of trial. By aid of this charm he won the prize and fled homeward with his comrades.

The fable may be interpreted thus: The people of Colchis washed the gravel of a gold-bearing stream into sluice boxes on the bottom of which they placed sheepskins, to arrest the fine gold. When sufficient had accumulated they removed the skins, shook free the coarse particles of gold, and hung the fleece to dry, so that the fine gold might be beaten out of it and collected. Thus the Greek mariners heard of a land in which golden fleeces hung on trees in a sacred grove near the shore of the Euxine. Jason represents adventurous youth, the seeker who goes forth across the sea with his comrades on the miner's quest; he finds he must perform prodigies of labor before he can win the precious metal; in winning it he is aided by the sorceress Science, the modern Medea, who shows him how to use the skins for catching fine gold and even explains to him that the natural grease on the wool serves to increase the adhesion of the gold particles. The fleece is analogous to the wooly blanket that the early Californian diggers, the Argonauts of a later day, employed for the same purpose, and the boards pierced with holes, mentioned by Strabo, are rudimentary riffles such as were used by the placer miner in the gulches of the Sierra Nevada.

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Similar stories have been told in later days. In 1630 a shepherd on the Cerro de Pasco in Peru lit a campfire on the mountain side, and in the ashes he found the silver that had been melted out of the rock underneath. More recently Juan Bautista, a Mexican herdsman, discovered the riches of El Tajo, in Sinaloa, by a similar accident. Juan was chasing a stray sheep when his rosary, becoming entangled in a bush, was torn from his neck. Not stopping to recover it, he threw his hat to mark the spot; later, returning from the chase, in the twilight, he recovered his hat, but it being now too dark to search for the beads, he camped for the night. After making a fire, he fell asleep. Awakening before dawn, he seized an ember to light a cigarette of cornstalk. As he did so the light fell on something that glistened; he picked it up and took it to his *patron*, who recognized it as silver. The fire had roasted the ore and released the metal. Thus he also was initiated into the mysteries of the art of metallurgy.

Alluvial Gold Mined in Spain

Strabo, the Greek geographer, who wrote in 19 A.D., makes reference to alluvial mining in Spain, saying:

"Gold is not only dug from the mines, but likewise collected; sand containing gold being washed down by the rivers and torrents. It is frequently found in arid districts, but there the gold is not visible to the sight, whereas in those which are overflowed the grains of gold are seen glittering. On this account they cause water to flow over the arid places in order to make the grains shine; they also dig pits and make use of their contrivances for washing the sand, and separating the gold from it; so that at the present day more gold is procured by washing than by digging it from the mines. The Galatae (Gauls) affirm that the mines along the Kemmenus mountains (the Cevennes) and on their side of the Pyrenees are superior, but most people prefer those on this side. They say that sometimes, amid the grains of gold, lumps have been found weighing half a pound; these they call *palae* (nuggets); they need but little refining. They also say that in splitting open small stones they find small lumps, resembling paps (nipples), and that when they have melted the gold, and purified it by means of a kind of aluminous earth, the residue left is electrum. This, which contains a mixture of silver and gold, being again subjected to the fire, the silver is separated and the gold left pure."[3]

Gold sinks in sand, because the surface of the earth is constantly in a state of vibration; the water washes away the sand and exposes the bright particles of gold. Strabo's remark concerning the large proportion of gold won by washing gravel as compared with vein mining is sagacious, because primitive mining in all ages has been directed much more to alluvial deposits than to quartz veins, for obvious reasons, such as the greater ease of discovery and the simpler metallurgical treatment required. The nuggets need but little refining, he says; other writers, such as Agatharchides, use the Greek word *apuron*, or without fire; that is, so pure as not needing to be melted. Agatharchides, writing in 125 B.C., speaks of the Debai region in Arabia as follows:

"In these lands they find a quantity of gold, not dust melted and treated with technical skill, but produced by nature, and called by the Greeks, *apuron*. The smallest pieces are not less than an olive-stone, the medium sized equal a medlar, and the biggest a walnut. They wear these nuggets around their wrists and necks, threaded alternately with transparent stones, and sell them cheaply to their neighbors; copper is worth thrice, iron double, and silver ten times its weight of gold."

An excellent example of the law of supply and demand; the relative value of the metals has varied greatly at different times and in different places. A medlar, by the way, is a fruit like a small brown apple, about the size of an ordinary walnut. It is evident, however, that Agatharchides thought in terms of walnuts that, like some produced in California, were bigger than medlars. He refrained from exaggerating, for one would suppose that some of the nuggets might have been as large as potatoes.

Interpreting Strabo

Let us return to Strabo: the sentences that describe the refining of the gold have provoked much interesting discussion, partly on account of the difficulties of translating a description written evidently by a writer who had obtained his information at second-hand, and who himself did not understand the technical process to which he referred. The translation of the Greek *stupteriodeis* as "aluminous" is open to the objection that it is a flagrant anachronism, for the salt alumina was not identified until 1722, and the metal aluminum was not discovered until 1827. The Greek word signifies alum-bearing, for the Greeks knew *stupteria*, or alum, as an astringent earth that was used for cleaning cloth and for other purposes. The Romans called it *alumen*, from which our English word is derived. In this sense *stupteria* is used by Herodotus (II, 180). Pliny says[4] that it is "a sort of brine that exudes from the earth." In the same book he says that "the leading property of every kind of alumen is its remarkable astringency, to which, in fact, it is indebted for its name with the Greeks." The more recent translation of Strabo by Horace L. Jones substitutes "styptic" for the "aluminous" of the Hamilton version, but "styptic" is merely the English derivative from *stupteria* and is therefore no adequate translation; it is a scientific synonym for "astringent." *Stupteriodeis* is best translated "alum-bearing." However, to the Greeks of Strabo's time *stupteria* stood not only for alum, a sulphate of alumia and potash (or soda), but also for green vitriol, which is ferrous sulphate. Either of these substances, when heated, evolves sulphuric acid, and therefore either of them might have the effects mentioned by Strabo, as Percy remarks[5]. The process described by Strabo is the one known as "cementation," whereby a chemical change is produced in a substance by heating it while embedded in a powdered mass of another substance. Many Greek scholars, including W. E. Gladstone, Mark Pattison, and William Smith, have studied

[3] The translation of H. C. Hamilton and W. Falconer.

[4] "Natural History," XXXV, 52.

[5] Percy's "Silver and Gold," p. 401.

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[2] "Mineralogia Cornubiensis," p. 246.

the first discovery of metals to the burning of forests, the heat sufficing to sweat them out of the rocks. Both Diodorus and Strabo quote Posidonius, a Syrian Stoic of 136-51 B.C., who asserts that a forest in the Pyrenees was set afire by shepherds, and the heat unloosed the treasures of the earth. Diodorus says: "The surface of the burned ground ran with much silver, and the natural substance (ore) from which silver is got having been fused, many streams of pure silver were produced." Aristotle repeats this tale; he says that "in Iberia when the coppices were set on fire by certain shepherds and the earth was heated by the wood, the country visibly flowed with silver, which was collected and brought no ordinary revenue to the Massilians," the people of Massilia, or Masseilles.

Similar stories have been told in later days. In 1630 a shepherd on the Cerro de Pasco in Peru lit a campfire on the mountain side, and in the ashes he found the silver that had been melted out of the rock underneath. More recently Juan Bautista, a Mexican herdsman, discovered the riches of El Tajo, in Sinaloa, by a similar accident. Juan was chasing a stray sheep when his rosary, becoming entangled in a bush, was torn from his neck. Not stopping to recover it, he threw his hat to mark the spot; later, returning from the chase, in the twilight, he recovered his hat, but it being now too dark to search for the beads, he camped for the night. After making a fire, he fell asleep. Awakening before dawn, he seized an ember to light a cigarette of cornstalk. As he did so the light fell on something that glistened; he picked it up and took it to his *patron*, who recognized it as silver. The fire had roasted the ore and released the metal. Thus he also was initiated into the mysteries of the art of metallurgy.

Alluvial Gold Mined in Spain

Strabo, the Greek geographer, who wrote in 19 A.D., makes reference to alluvial mining in Spain, saying:

"Gold is not only dug from the mines, but likewise collected; sand containing gold being washed down by the rivers and torrents. It is frequently found in arid districts, but there the gold is not visible to the sight, whereas in those which are overflowed the grains of gold are seen glittering. On this account they cause water to flow over the arid places in order to make the grains shine; they also dig pits and make use of their contrivances for washing the sand, and separating the gold from it; so that at the present day more gold is procured by washing than by digging it from the mines. The Galatae (Gauls) affirm that the mines along the Kemmenus mountains (the Cevennes) and on their side of the Pyrenees are superior, but most people prefer those on this side. They say that sometimes, amid the grains of gold, lumps have been found weighing half a pound; these they call *palae* (nuggets); they need but little refining. They also say that in splitting open small stones they find small lumps, resembling paps (nipples), and that when they have melted the gold, and purified it by means of a kind of aluminous earth, the residue left is electrum. This, which contains a mixture of silver and gold, being again subjected to the fire, the silver is separated and the gold left pure."[3]

Gold sinks in sand, because the surface of the earth is constantly in a state of vibration; the water washes away the sand and exposes the bright particles of gold. Strabo's remark concerning the large proportion of gold won by washing gravel as compared with vein mining is sagacious, because primitive mining in all ages has been directed much more to alluvial deposits than to quartz veins, for obvious reasons, such as the greater ease of discovery and the simpler metallurgical treatment required. The nuggets need but little refining, he says; other writers, such as Agatharchides, use the Greek word *apuron*, or without fire; that is, so pure as not needing to be melted. Agatharchides, writing in 125 B.C., speaks of the Debai region in Arabia as follows:

"In these lands they find a quantity of gold, not dust melted and treated with technical skill, but produced by nature, and called by the Greeks, *apuron*. The smallest pieces are not less than an olive-stone, the medium sized equal a medlar, and the biggest a walnut. They wear these nuggets around their wrists and necks, threaded alternately with transparent stones, and sell them cheaply to their neighbors; copper is worth thrice, iron double, and silver ten times its weight of gold."

An excellent example of the law of supply and demand; the relative value of the metals has varied greatly at different times and in different places. A medlar, by the way, is a fruit like a small brown apple, about the size of an ordinary walnut. It is evident, however, that Agatharchides thought in terms of walnuts that, like some produced in California, were bigger than medlars. He refrained from exaggerating, for one would suppose that some of the nuggets might have been as large as potatoes.

Interpreting Strabo

Let us return to Strabo: the sentences that describe the refining of the gold have provoked much interesting discussion, partly on account of the difficulties of translating a description written evidently by a writer who had obtained his information at second-hand, and who himself did not understand the technical process to which he referred. The translation of the Greek *stupteriodeis* as "aluminous" is open to the objection that it is a flagrant anachronism, for the salt alumina was not identified until 1722, and the metal aluminum was not discovered until 1827. The Greek word signifies alum-bearing, for the Greeks knew *stupteria*, or alum, as an astringent earth that was used for cleaning cloth and for other purposes. The Romans called it *alumen*, from which our English word is derived. In this sense *stupteria* is used by Herodotus (II, 180). Pliny says[4] that it is "a sort of brine that exudes from the earth." In the same book he says that "the leading property of every kind of alumen is its remarkable astringency, to which, in fact, it is indebted for its name with the Greeks." The more recent translation of Strabo by Horace L. Jones substitutes "styptic" for the "aluminous" of the Hamilton version, but "styptic" is merely the English derivative from *stupteria* and is therefore no adequate translation; it is a scientific synonym for "astringent." *Stupteriodeis* is best translated "alum-bearing." However, to the Greeks of Strabo's time *stupteria* stood not only for alum, a sulphate of alumia and potash (or soda), but also for green vitriol, which is ferrous sulphate. Either of these substances, when heated, evolves sulphuric acid, and therefore either of them might have the effects mentioned by Strabo, as Percy remarks[5]. The process described by Strabo is the one known as "cementation," whereby a chemical change is produced in a substance by heating it while embedded in a powdered mass of another substance. Many Greek scholars, including W. E. Gladstone, Mark Pattison, and William Smith, have studied

[3] The translation of H. C. Hamilton and W. Falconer.

[4] "Natural History," XXXV, 52.

[5] Percy's "Silver and Gold," p. 401.

this passage with a view to a correct interpretation. They agree that the electrum (a gold-silver alloy) was obtained from the impurities removed during the first operation of refining, but this byproduct, as Percy says, should have been silver, without gold. Of course, if Strabo did not know what really was done, it is almost waste of time to take pains to translate accurately what he wrote. On the whole, it seems reasonable to conclude that the gold, which contained a large proportion of silver, was subjected twice to cementation with ferrous sulphate; by the first operation the ratio of silver was reduced to that of electrum—that is, to about one-fifth of the alloy; and by the second operation the remaining silver was removed from the gold.

PLINY'S MEANING OBSCURE

Pliny has an analogous passage in his "Natural History"[6]; he says that the gold "is heated with twice its weight of salt and thrice its weight of *misy*, and again with two portions of salt and of the stone called schist; and so when these substances are burned together in an earthen crucible, it (the gold) throws out the virus (or impurity), remaining itself pure and unadulterated." Here, apparently, we have a description, by no means clear, of the refining of gold by cementation with common salt. The substance that Pliny calls *misy* is probably native yellow copperas, a basic sulphate of iron, known to mineralogists as copiapite. It is the product of weathering or oxidizing action upon common pyrite. In Pliny's day (about 75 A.D.) the best *misy* came from Cyprus. The schist represents a silicate of alumina. When subjected to a red heat this yellow copperas, like the green variety, one being named *misy* by Pliny and the other *stupteria* by Strabo, would emit sulphuric acid, which, reacting on the salt, would lead to the production of chlorine, which then would combine with the silver, forming a chloride that could be leached with brine or volatilized by an increase of heat, or absorbed in the ash, leaving the pure gold behind. Strabo does not mention the addition of salt at the Spanish mines, because, it is fair to suppose, he did not know enough about the technique of the process. Some such method of refining must have been known to the ancients; otherwise it is not possible to explain the purity of the gold they produced.

HOW GOLD WAS REFINED IN NUBIA

Next we have the description of the refining of gold at the Egyptian mines in Nubia as recorded by Agatharchides. He says:

"They put it into earthenware pots, and having mixed according to the quantity a proportionate lump of lead and grains of salt and just a little tin they also throw in some barley bran, and having made a fitted cover and smearing it round the edges very carefully with clay, they bake it in an oven five days and as many nights without cease; then when they have let it get cold they find of the other things nothing left in the pots, but the gold they find pure, a little reduced in quantity."

The tin was added probably to harden the gold; the lead served as a scorifier, or cleanser; the barley bran was a reducing agent; and the salt served to remove the silver as a volatile chloride. The careful luting of the cover of the crucible, however, indicates that the operation was performed in a container that was tightly closed, so that the byproducts could disappear only by absorption into the clay of the crucible. This description of Agatharchides, quoted by Diodorus, is confused. Gowland suggests[7] that the process may have been similar to one he saw the Japanese using in 1872. He says:

"The gold from the final washing was mixed with common salt and clay, and piled up in the form of a cone in a broad shallow crucible. The whole was then introduced into a furnace containing charcoal as fuel and kept at red heat for twelve hours, by which means any silver contained in the gold was converted into chloride. The dish with its contents was then removed, washed with hot brine and water, the silver chloride was dissolved and the gold left in a purified state."

PLINY AN AMATEUR

Pliny's account of alluvial mining on a large scale, as he probably saw it in Spain, constitutes a part of one of the longest technical descriptions in the classics, but, like most of his attempts to describe mining or metallurgical operations, it is confused. Pliny knew next to nothing about mining, despite his short term of office as *procurator metallorum* in Spain under Vespasian in 73 A.D.; his writings are those of a layman; they suggest the kind of description that would be forthcoming from a Sunday-school teacher or a veterinary surgeon after a visit, for example, to the copper mines of Butte or Bisbee. In his "Natural History" (XXXIII, 21) he says:

"Gold is found in our part of the world, not to mention the gold extracted from the earth in India by the ants and in Scythia by the griffins. Among us it is procured in three different ways, the first of which is in the form of dust, which is found in running streams, such as the Tagus in Spain, the Padus (Po) in Italy, the Hebrus in Thracia, the Pactolus in Asia (Minor), and the Ganges in India. Indeed there is no gold found in a more perfect state than this, it being thoroughly polished by continued attrition in the stream. . . . Others by equal labor and greater expense bring rivers from the mountain heights a distance of as much as a hundred miles, for the purpose of washing this débris. The ditches thus made are called *corrugi* from our word *corrivatio* (the bringing of water into one channel), I suppose; and even when these are once made they entail a thousand fresh labors. The gradient, for instance, must be so steep that the water may rush rather than flow from the most elevated points. Then the valleys and ravines have to be crossed, by the aid of aqueducts, and in other places impassable rocks have to be cut away and forced to make room for troughs of logs that have been hollowed, those thus engaged being suspended by ropes, so that to a spectator the workmen have the appearance not so much of wild beasts as of birds on the wing. Hanging thus, they take the levels and trace the lines that the ditch is to take; and in this way are rivers conducted by the hand of man even where there is scarcely a place for his footstep. The water, too, is considered in an unfit state for washing (the gold-bearing alluvium) if the current of the stream carries any mud along with it. The kind of earth that yields this mud is known as *urium* (limestone or dolomite), and hence it is that in tracing these channels they carry the water (in a ditch) over beds of silex (or pebbles) and carefully avoid this *urium*. When they have reached the head of the fall, at the very brow of the mountain, reservoirs are excavated, a couple of hundred feet in length and breadth, and some ten feet in depth. In these reservoirs usually five sluices are left, about three feet square, so that the moment the reservoir is filled the floodgates are struck away, and the torrent bursts forth with such a degree of violence as to roll onward any fragments of rock that may obstruct its passage. When they have reached the level ground, there is still another labor that awaits them. Trenches, known as *agogae*, have to be dug for the passage of the water; and in these, along the bottom, at regular intervals, is placed a layer of *ulex*. This *ulex* is a plant like rosemary in appearance, rough and prickly, and well suited for arresting any pieces of gold that may be carried along (by the water). The sides, too

[6] XXXIII, 4, 25.

[7] "The Metals in Antiquity," by William Gowland, Royal Anthropological Institute, 1912.

(of the trenches), are lined with plants, and are supported by arches where they pass over steep and precipitous spots. (Evidently the trench must deliver into a flume along such places). The earth, carried onward in the stream, arrives at the sea at last, and thus is the shattered mountain washed away. . . . The *ulex* that is used for the above purpose is dried and burned, after which the ashes of it are washed upon a bed of grassy turf, in order that the gold may be deposited thereon."

The storage of water in reservoirs and the sudden release of the water down a steep slope is the American miner's method of "booming," which is used where water is insufficient for continuous sluicing. Pliny's description also reminds one of the method known as "hushing" in parts of England, where the water from a reservoir is released suddenly so as to scour the ground, remove the soil, and expose any veins that may outcrop underneath. This method, it is believed, was used by the Romans when prospecting for veins of lead ore on Shelve hill, in Shropshire. In regard to the use of a prickly shrub to arrest the fine gold and the burning of it subsequently, it is noteworthy that Agricola mentions Pliny's description, and states that grassy turf was used in Germany for much the same purpose. He says[8]:

"Some people construct a frame not unlike the one covered with canvas, but shorter. In place of the canvas they set pieces of turf in rows. They wash the sand, which has been thrown into the head of the frame, by letting in water. In this way the particles of gold settle in the turf. . . . The particles that have clung to the turf are afterward washed down into the settling pit or trough by a stronger current of water. . . . The concentrate is finally collected and washed in a bowl."

Vein Mining According to Pliny

Pliny's description of vein mining is as follows:

"A second method of obtaining gold is by sinking shafts or seeking it among the débris of mountains, both of which methods it will be as well to describe. The persons in search of gold in the first place remove the surface earth that gives indication of the presence of gold. This done, a trench is made, the sand of which is washed, and according to the residue found after washing a conjecture is formed as to the richness of the vein."

In modern technical English we would say that the prospector strips the soil from the rocky surface, and digs a trench, the fine stuff from which he then washes in a pan to ascertain how much gold it contains. The washing probably was done in a wooden bowl, like a *batea*. Pliny continues:

"Sometimes indeed gold is found at once in the surface earth, a success however but rarely experienced. Recently, for instance, in the region of Nero, a vein was discovered in Dalmatia that yielded daily as much as 50 lb. weight of gold. The mountains of Spain, in other respects arid and sterile, and producing nothing whatever, are thus constrained by man to be fertile, in supplying him with this precious metal."

The Dalmatian deposit was fairly rich, and Pliny's mention of it prompts me to record that Dick Lowe, working on Bonanza Creek, in the Klondike district, in 1898, cleaned up $46,000 in eight hours. In regard to the sterility of the Spanish mountains and man's ability to make such a region financially fertile, it is to be remarked that gold is commonly won in the waste places of the earth, which, again, are only too frequently irrigated with unrequited capital.

Next Pliny says:

"The gold that is extracted from shafts is known by some persons as *canalicum;* it is found adhering to the gritty crust of marble, and altogether different from the form in which it sparkles in the sapphires of the East and in the stone of Thebais and other gems, it is seen interlaced with the particles of the marble. The channels of these veins are found running in various directions along the sides of the shafts; hence the name of the gold they yield—*canalicum.*"

This term is analogous to our word "lode," which western American miners commonly change to "lead"; which is etymologically correct, for "lode" is a form of "lead," being derived from the Old English *laedan,* to guide or conduct. So also our word "vein" as applied to ore originated from the likeness between the membranous tubes that conduct the blood in the human body and the channels along which mineral has been deposited from aqueous solution. Pliny's "marble" is quartz; his "sapphires" are malachite or lapis-lazuli; his "stone of Thebais" is porphyry. He continues:

"In the shafts the superincumbent earth is kept from falling in by means of wooden pillars (or props). The substance that is extracted is first broken up, and then washed; after which it is subjected to the action of fire and ground to a fine powder. This powder is known as *apitascudes,* while the silver which becomes disengaged in the furnace has the name of *sudor* (sweat) given to it. The impurities that escape by the chimney, as in the case of all other metals, are known by the name of *scoria* (slag). In the case of gold, this *scoria* is broken up a second time, and melted over again. The crucibles used for this purpose are made of *tasconium,* a white earth similar to potter's clay in appearance; there being no other substance capable of withstanding the strong current of air, the action of the fire, and the intense heat of the melted metal."

This description of a metallurgical process is typical of Pliny's writings on our subject; it is that of an unsophisticated layman, and therefore difficult to understand. The use of fire, to cause the quartz to crack and decrepitate, was an extension of the practice underground, known as "fire-setting," by which hard rock was made amenable to simple tools after being exposed to a fire, sometimes followed by a douche of water. The silver apparently was separated from the gold by volatilization, after which, on cooling, it condensed in drops, like sweat. Pliny's use of *scoria* for impurities, such as silver, that escape by the chimney of the furnace, indicates the confusion in his understanding. The residue, after sundry impurities have been expelled by volatilization, was crushed and then melted in a crucible made of the best clay. The crucible, or cupel, is named *tasco* in Spain today and the fireclay is still known as *tasconio.*

We have had rough descriptions of alluvial mining and of vein mining by means of shafts; next we have Pliny's account of adit-levels. He says:

"The third method of obtaining gold surpasses the labors of the giants even; by aid of galleries driven to a long distance, mountains are excavated by the light of torches, the duration of which forms the set times for work, the workmen never seeing the light of day for many months together. These mines are known as *arrugiae;* and not infrequently clefts are formed on a sudden, the earth sinks in, and the workmen are crushed beneath; so that it would really appear less rash to go in search of pearls and *purpuras* (purples) at the bottom of the sea, so much more dangerous to ourselves have we made the earth than the water. Hence it is that, in this kind of mining, arches are left at frequent intervals for the purpose of supporting the weight of the mountain above."

Hannibal's Silver Mine

Elsewhere Pliny tells us that Hannibal had a silver mine, named the Baebulo, in a mountain that had been penetrated for a distance of 1,500 paces, or 1½ miles.

[8] *Op. cit.,* p. 333.

"Throughout the whole of this distance," he says, "there are water-carriers standing night and day, bailing out the water in turns, aided by the light of torches, and so forming quite a river." It is to such workings that he refers in the above account of long galleries driven into mountains. The torches were resinous, so as to give a long flame. Such were the lamps of earliest antiquity, before oil was used. The caving of the ground in consequence of unsystematic excavation or careless digging has ever been one of the perils that the miner faces. In modern days this caving has been utilized scientifically as a method of causing a natural breaking of the ore underground. The mention of the *purpuras*, or "purples," is a reference to the murex, a marine shellfish from which the Phoenicians obtained the red dye that gave fame to Tyre. Evidently the use of wooden props and of arches of standing ground for supporting large openings was understood by the Romans, because Pliny mentions both, but it is regrettable that he says so little concerning these rudiments of mining technique.

Silver Booty for Roman Conquerors

Hannibal's mine, the Baebulo, near Guadalcanal, in southern Spain, is said by Pliny to have yielded 300 lb. weight of silver daily. This he used as the sinews of war in his campaigns against the Romans; and when at last they defeated him and destroyed Carthage, in 146 B.C., the conquerors drew great stores of silver from Spain, as is proved by the quantities of metal carried by the returning generals in their triumphal marches through the imperial city on the Tiber. History tells us that Hannibal married a lady of Castulo named Himilce, and it is owing to this tradition probably that sundry ancient workings near Castulo are known today as Los Pozos de Anibal, or the pits of Hannibal. These workings were reopened by a German company about fifty years ago, and in 1875 one of the engineers found a remarkable relic of the past in the form of a bas-relief. This was engraved on a slab of sandstone, which originally must have been about 20 in. square. When found it was being used by an old women who was busily engaged in washing her linen upon it. This engraving on stone represents a gang of laborers on their way to work in the gallery of a mine. Five men are in front, and in the background four others are indicated. The last one in the front row is the tallest; he is the foreman, and carries in his right hand what looks like a truncheon; his left hand is passed through the ring of an object that has been surmised to be either a bell or a container for the oil used in the lamps of the miners. The man in front of him carries a pick, or, more precisely, a clumsy implement that is pointed at one end and blunt at the other, so as to serve either as a pick or a hammer. The next man carries a lamp, but what the two others may have in their hands one cannot tell, because the surface of the stone has been worn away. For the same reason the feet, probably sandaled, are obliterated. The middle part of each man's body is covered by a tunic; over this is a leather apron, to protect the vital parts from injury by stones or by the panniers in which the ore was carried. The heads of the men are uncovered. The date of this bas-relief is about 200 A.D.

Pliny continues:

"In mining either by shaft or by gallery, barriers of silex are encountered, which have to be driven asunder by the aid of fire and vinegar; or, more frequently, as this method fills the galleries with suffocating vapors and smoke, to be broken in pieces by bruising machines shod with pieces of iron weighing 150 lb.; which done, the fragments are carried out on the workmen's shoulders, night and day, each man passing them on to his neighbor in the dark, it being only those at the pit's month that ever see the light. In cases where the bed of silex appears too thick to admit of being penetrated, the miner traces along the sides of it and so turns it. And yet, after all, the labor entailed by this silex is looked upon as comparatively easy, there being an earth—a kind of potter's clay mixed with gravel (*angadia* by name)—that is almost impossible to overcome. This earth has to be attacked with iron wedges and hammers like those previously mentioned, and it is generally considered that there is nothing more stubborn in existence—except indeed the greed of gold, which is the most stubborn of all things."

Use of Vinegar Doubtful

The silex, or flint, refers to bars, or "horses," as the modern miner calls them, of particularly hard siliceous rock—too tough for miners unprovided with the help of explosives. The use of fire, to crack such rock, is intelligible, but what service vinegar could render is beyond our conjecture. The mention of fume from the vinegar suggests noxious gases, and only adds to our perplexity. Elsewhere in his works (XXIII, 27) Pliny says:

"Poured upon rocks in considerable quantities, it (vinegar) has the effect of splitting them, when the action of fire alone has been unable to produce any effect thereon."

Hannibal, it will be remembered, is said by Tacitus to have used vinegar to break down the rocks that impeded the passage of his army across the Alps from Spain into Italy, but the statement has been deemed apocryphal by all competent commentators. The bruising machine, shod with iron weighing 150 lb., must have been a maul, like a pile-driver, that was raised and dropped, probably after having been hoisted by a rope that passed over a pulley or wheel. The pieces of broken ore, according to Pliny, were carried out of the mine on the workmen's shoulders—in panniers or hide bags, as is done today in Mexico and elsewhere. The gallery or level was so small, probably 2 ft. by 3 ft., that free movement was impracticable, so the bag of ore was passed from man to man until it reached those at the end of the chain, who alone were near enough to see daylight. This reminds one of the description left by Theophrastus, who was a pupil of Aristotle and wrote in about 300 B.C. He says:

"The diggers in the pits of Samos can not stand upright at their work, but are obliged to lie down either on their back or on one side; for the vein of the earth they dig runs lengthwise, and is only of the thickness of about two feet, though considerably more in breadth, and is inclosed on every side with stones, from which the ore is drawn forth."

"Rabbit Burrows"

The mine workings of the ancients were small; it is significant that one of the Roman terms for a mine was *cuniculus*, the word for a rabbit. The word "Spain" is said to have come from the Phoenician *spanja*, also meaning a rabbit, and referring to the burrows made by the natives in search of ore. Such were the openings made by the Japanese as Gowland saw them in 1874. He says: "The excavations were mere burrows, in some places so small that they could hardly be traversed even by crawling on hands and knees, and winding about in a tortuous manner, avoiding all the

hardest and poorest parts of the vein."[9] Where rich ore was hard, they missed it.

How primitive methods survive is illustrated by operations at the lead mines of Ajmir, in India, in 1831, as described by a British officer:[10]

"The excavation in following a vein of ore is only made large enough to admit of a man moving on his hands. . . . The mining tools are few and simple in construction; they consist of two or three hammers of different weights, of iron chisels or wedges edged with steel, and a few one-handed picks. The miners begin work about sunrise, each man carrying a small lamp in one hand. The ore is broken as it is gotten in small pieces, for convenience of carriage, and put into small bamboo baskets. As the gallery is not high enough to allow the miners to stand upright, they sit on their haunches in a row and pass the baskets on from one to another. When the whole has reached the foremost man, they move upwards and again seat themselves in a row; and this is repeated until the mouth of the mine is reached."

Evidently the excavation sloped downward from the surface. The ore was broken by aid of fire-setting.

Next, we have Pliny's reference to soft, but tough, rock, such as the American miner would call "gouge," and to the Australian is known as "pug." He says that this clay, mixed with gravel, is attacked with iron wedges and hammers, so it is hard to understand what he means. In his description of the hard rock, or silex, and the soft rock, or clay with gravel, it looks as if he were comparing the two different kinds of ground encountered respectively in vein mining and alluvial mining, more particularly of the type known to us as drift mining—that is, the exploitation of a gold-bearing sediment by means of a level or gallery underneath an overburden of alluvium and soil. This clay and gravel, he says, is more stubborn than anything except perhaps the hunger for gold, the *sacra fames auri*, against which Virgil, Seneca, and other Roman moralists of that day inveighed, as many have done in our own times. Seneca deplored man's avarice in digging metals out of the earth; iron he regarded as the instrument of murder; gold and silver as its reward. Pliny looked upon earthquakes as an expression of Mother Earth's indignation at man's intrusion into her very vitals. "Gold," he exclaims, "was discovered only for the ruin of mankind; would that it might be banished and the happy age of barter return!"

[9]"Early Metallurgy of Copper, Tin and Iron in Europe," by William Gowland, Archaeologia, 56 (2).
[10]Percy's "Metallurgy of Lead," p. 294.

Early Amalgamation

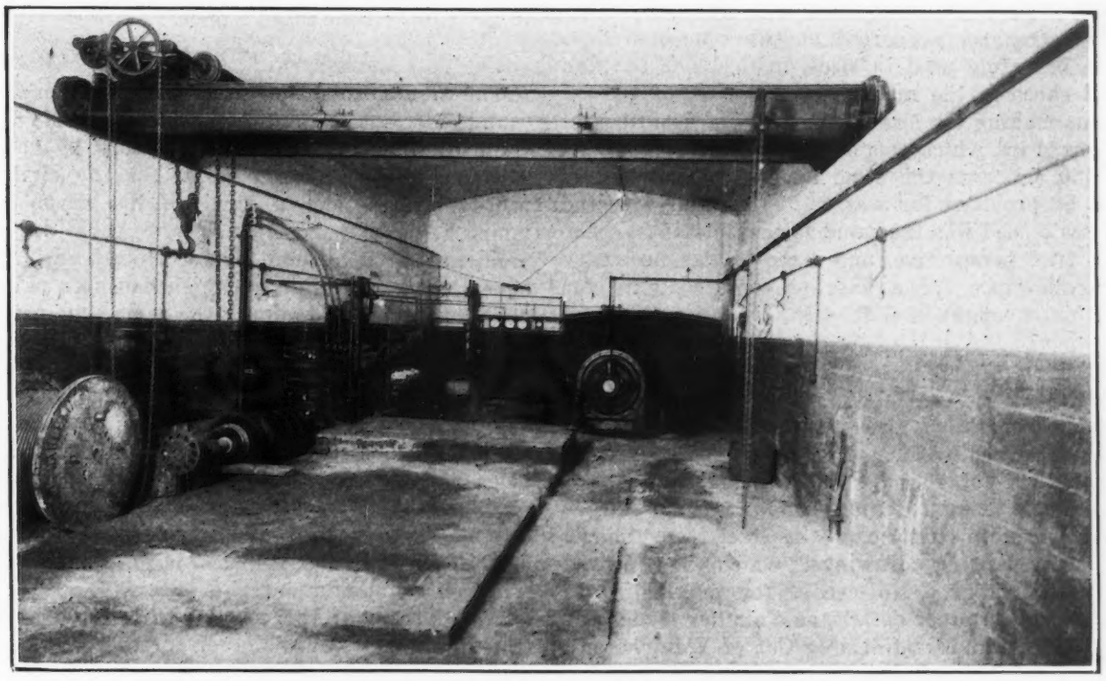
Pliny refers to the use of mercury for the amalgamation of gold; he says:[11]

"All substances float upon the surface of quicksilver, with the exception of gold, this being the only substance that it attracts to itself. Hence it is such an excellent refiner of gold; for, on being shaken briskly in an earthen vessel with gold, it rejects all the impurities that are mixed with it. When once it has thus expelled these superfluities, there is nothing to do but to separate it from the gold; to effect which it is poured out upon skins that have been well tawed, and so, exuding through them like a sort of precipitation, it leaves the gold in a state of purity behind."

The skins evidently have been made into leather without the use of tannin, by soaking them in a solution of alum and salt. We use soft chamois leather for straining the mercury, in the manner Pliny describes. For mercury he used the words *argentum vivum*, of which quicksilver is a literal translation. In his day mercury and silver were supposed to be variant forms of the same substance; Pliny says of certain silver veins in Spain that "there is a mineral also found in these veins of silver that yields a humor always liquid, known as quicksilver." It may be that his mention of "the exhalations from silver mines" that are "dangerous to all animals, but to dogs more particularly," refers to the fumes of mercury, and to poisoning by salivation.

(*To be continued.*)

[11]Natural History," XXXIII, 32.



A Comparison of Space Requirements for Pumping

At the far end of this room is an automatically controlled motor-driven centrifugal pump which does the work formerly done by a reciprocating unit, the foundation of which is seen in the foreground at the left

How to Build a Steel Frame for a Mine Model

Details of Structure for Supporting Sheets of Glass—Importance of Good Illumination—Duplicating on Reduced Scale by Photography

By Cleveland O. Moss

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WHEN the dimensions of a mine model with horizontal glass sheets approach 3½x7 ft. with a height of 5 ft. plus, the frame for supporting the glass becomes somewhat of a problem. As far as I am aware, no description of a satisfactory design for a frame of this size has heretofore been published, and it is hoped that the accompanying detailed drawings will be of value to others. The model described in this article was built for the Stratton Lease, which is operating the property of the Stratton Cripple Creek Mining & Development Co. at Victor and Cripple Creek, Colo. This property comprises over 600 acres, approximately 400 of which are in the Globe Hill-Poverty Gulch Group and 200 in the Bull Hill Group. Inasmuch as the American Eagles shaft, on Bull Hill, had been selected as the base of operations, it was desired to build a model that would cover as much of this group as possible. Most of the existing maps were drawn on a scale of 40 ft. to the inch, and to save time this scale was adopted. Glass of double strength, supported at two opposite edges only, can be safely used in sizes up to 42x42 in., and each full sheet in the model was made up of two of these, thus making the size of the glass of a horizontal section 42x84 in., which was sufficient to cover approximately 130 acres on the scale adopted. The vertical depth to be provided for was 2,100 ft., and since the vertical scale used was the same as the horizontal scale, to get a true perspective, and since it was necessary to make allowance for a base to contain lights for illumination, a height of 5 ft. 4 in. from the floor was decided upon.

Rigid Setting for Model Advisable

A wooden frame for a glass model 24x42 in. in dimensions was described by E. D. North in the *Transactions* of the A.I.M.E., Vol. 40, page 755. Such a frame, however, was not thought rigid enough for our larger model. I therefore constructed the steel frame shown in the accompanying drawings, which has proved entirely satisfactory. No credit for originality is claimed, except in minor details, as a similar model was used by the Portland Gold Mining Co., of Victor, credit for which is due Fred Jones, superintendent for the Portland company. The principal changes that were made were in the base, where, to increase the rigidity of the frame, the ends and sides below the glass, and the bottom, were made of No. 10 sheet iron instead of wood.

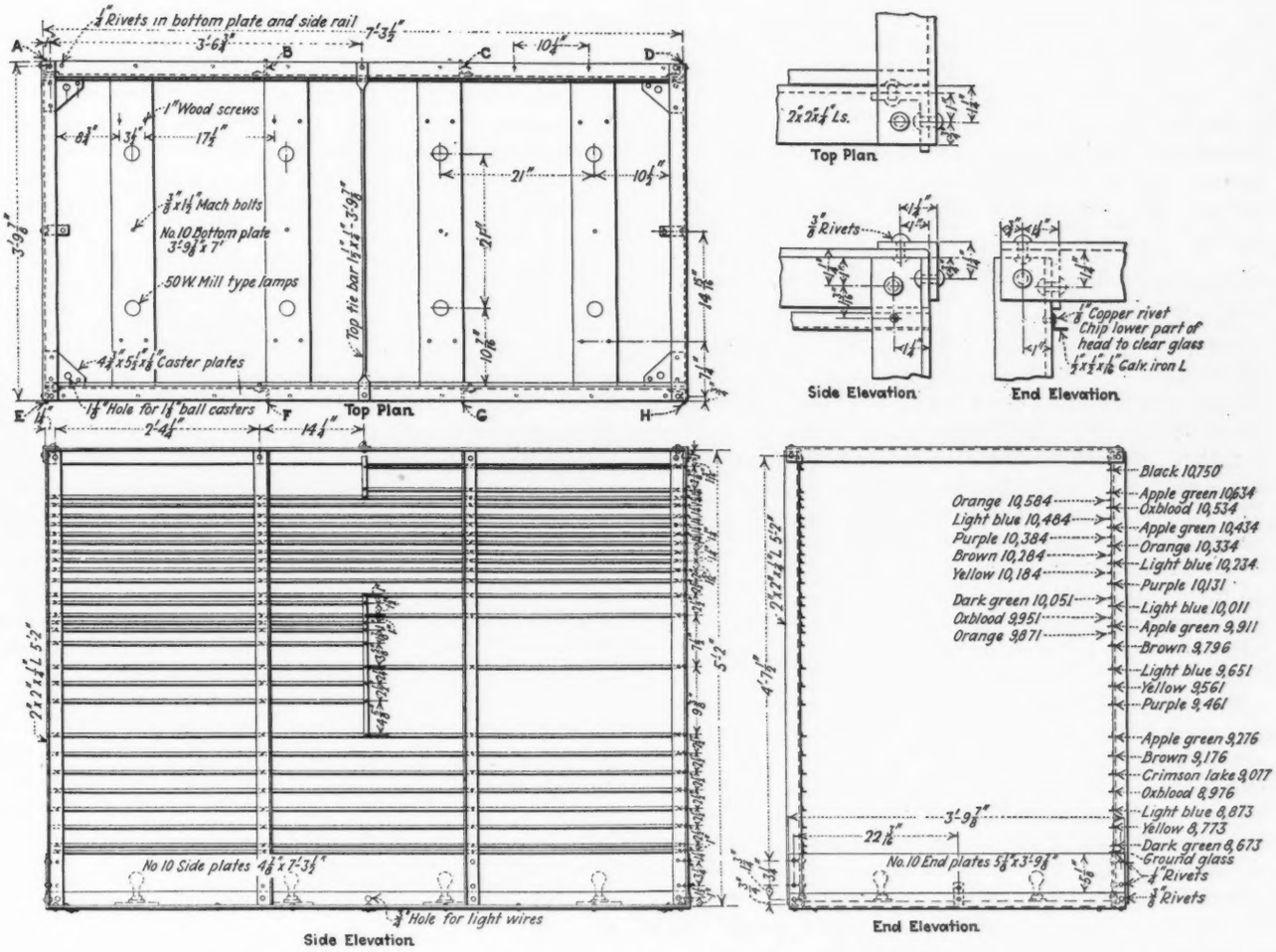
It will be noted in the design that the glass is put in and removed from the ends, so that, if the model is to remain in one spot, the distance from each end to the nearest wall should not be less than 4 ft. To provide for moving, if necessary, the model is supported by six ball casters. The weight has proved a little too great, however, for easy moving on ball casters, and heavy truck-type casters are therefore recommended. In our office, frequent moving is necessary to get at the glass for cleaning or to bring the mine work up to date, and it might be thought that the lack of diagonal bracing would allow distortion of the frame, with consequent breakage of glass. This, however, is not the case. The model can be pulled and hauled around or leaned upon with impunity.

Careful Construction Necessary

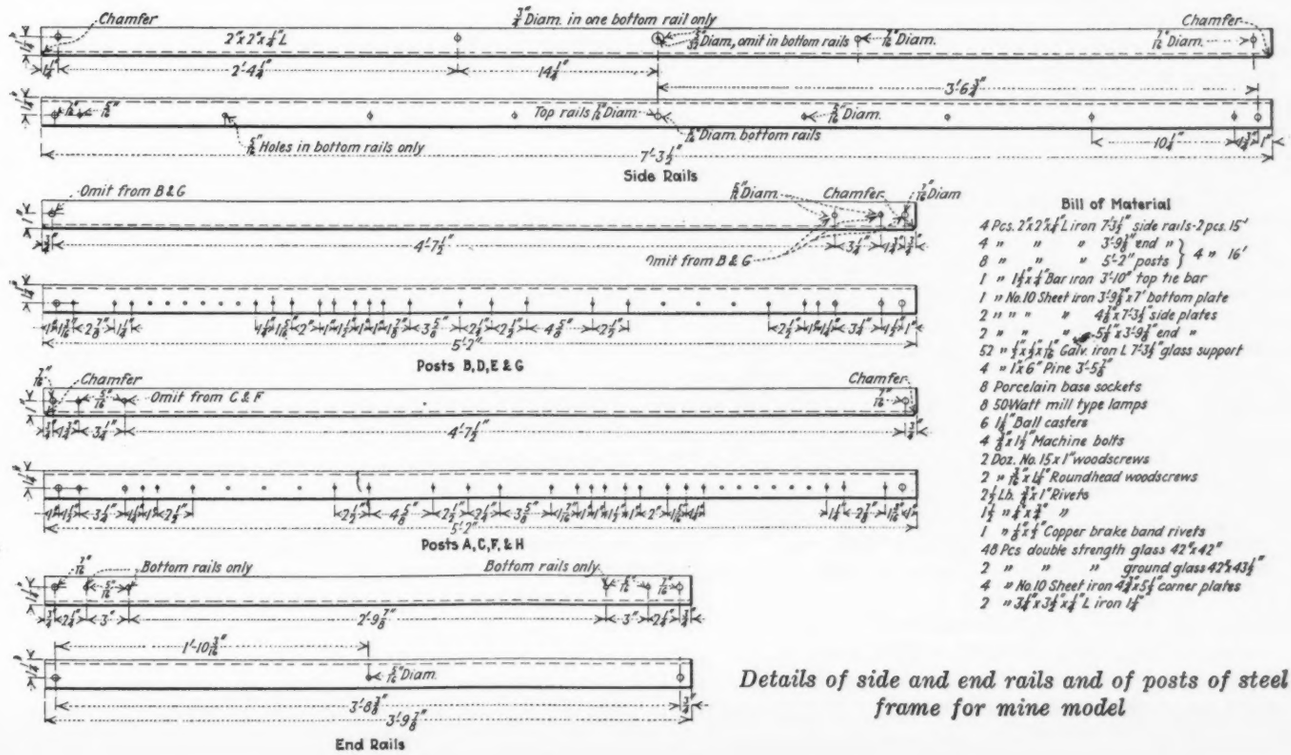
Attention is called to the construction of the corners, where a tight, accurate fit of the angle irons helps stiffen the frame. The angles and plates should be laid out accurately for drilling, and, before riveting, the frame should be bolted together and carefully leveled, plumbed, and squared. Temporary diagonal bracing of telephone wire, doubled and twisted up with a nail, will hold the frame true while riveting. After riveting the frame, the ½x½x⅛-in. angles used to support the glass are riveted on with copper rivets, the heads of which are chipped, as shown in the drawing, to avoid interference with the glass. The dimensions given allow ⅛ in. on each side for variations in width of the glass. This proved to be enough but not too much. The appearance of the model can be improved by making these supporting angles of brass, but galvanized iron is more easily obtained and is cheaper. The frame should be painted with several coats of white paint, followed by one of enamel, care being taken not to get paint on the small angles.

Good Lighting Necessary

The arrangement shown to provide illumination was found sufficient at night but none too good in the daytime. We have improved it recently by substituting nineteen 25-watt Mazda lamps for the eight 50-watt mill-type lamps shown, three of the eleven additional lamps being placed on the bottom, three on each side, and one on each end. The bottom, ends, and sides, beneath the ground glass, which had been painted with white enamel paint, were at the same time painted with aluminum paint, which proved a better reflector. The two enemies of good illumination, which is necessary when so many sheets of glass have to be looked through, are dust on the glass and outside light. Both can be excluded by building removable wooden panels in the sides and ends of the frame and putting on a fixed plate-glass top, or glass panels can be used if a side or end view of the mine workings is wanted. Our model is in such constant use, however, that we simply strung brown denim curtains on a wire around the top, and tied them at the corners with tapes at intervals of a foot. A removable cover for the top was made of black oilcloth with a wooden roller tacked to each side. This is easily rolled up and stood in a corner, and the curtains can be lifted for a side or end view, or to



Details of construction of steel frame designed to support glass sheets of mine model


Chamfer
⅜" Diam. in one bottom rail only
⅝" Diam. omit in bottom rails
½" Diam.
2" x 2" x ¼" L
Top rails ½" Diam.
⅝" Holes in bottom rails only
⅝" Diam. bottom rails
Side Rails
Omit from B & G
⅝" Diam.
Omit from B & G
Posts B, D, E & G
Omit from C & F
Posts A, C, F, & H
Bottom rails only
End Rails

Bill of Material

4 Pcs. 2" x 2" x ¼" L iron 7'-3½" side rails-2 pcs. 15"
4 " " " 3'-9⅞" end " } 4 " 16'
8 " " " 5'-2" posts }
1 " 1¼" x ¼" Bar iron 3'-10" top tie bar
1 " No. 10 Sheet iron 3'-9⅞" x 7" bottom plate
2 " " " " 4⅞" x 7'-3½" side plates
2 " " " " 5⅛" x 3'-9⅞" end "
52 " ½" x ½" x ⅛" Galv. iron L 7'-3½" glass support
4 " 1" x 6" Pine 3'-5⅛"
8 Porcelain base sockets
8 50 Watt mill type lamps
6 1¼" Ball casters
4 ⅜" x 1½" Machine bolts
2 Doz. No. 15 x 1" woodscrews
2 " ⅛" x 1¼" Roundhead woodscrews
2½ Lb. ⅜" x 1" Rivets
1½ " ⅜" x ¾" "
1 " ⅜" x ¾" Copper brake band rivets
48 Pcs double strength glass 42" x 42"
2 " " " ground glass 42" x 43½"
4 " No. 10 Sheet iron 4½" x 5½" corner plates
2 " 3¼" x 3¼" x ¼" L iron 14"

Details of side and end rails and of posts of steel frame for mine model

permit the insertion of a pointer between sheets or the removal or replacement of glass. If there is sufficient headroom, a tent to cover the whole model when it is not in use can be used to exclude dust. This can be suspended by sash cord from pulleys overhead and pulled up out of the way when the model is in use. Benches are placed alongside the model so that those using it can look down through the top. A snap switch on the wall makes it easy to turn the lights on or off as desired.

How the Glass Is Handled

A few notes on the handling of the glass may be helpful to those not familiar with the procedure. The glass should first be thoroughly cleaned. It is then placed over a map of the level to be shown thereon and the workings are traced on the glass in the color chosen for that level. The elevation is written alongside the level near the shaft, in the same color as the level. The glass is usually slightly warped and the convex side should be up when the glass is placed in the frame, so as to correct the sag as far as possible. Artists' oil paints, thinned with a drier, or Jap-a-lac, are used for drawing on glass. The drier may be turpentine, but a mixture half turpentine and half white japan is better. The consistency must be such that the paint will flow readily from a ruling pen, but will not spread. Experience will soon teach the proper mix. Jap-a-lac has just the right consistency, but is no longer everywhere obtainable nor always to be had in the desired colors. If it can be obtained, it is particularly desirable for claim, boundary and co-ordinate lines on account of the large quantity of it required and its quick-drying properties. Steel straight-edges are much better for use on glass than wooden ones, as their weight tends to prevent slipping. Co-ordinate lines 500 ft. apart and boundary lines are drawn on all sheets, the former in any color desired and the latter in black. Claim lines are drawn in black on the top sheet only, or, if preferred, on the bottom sheet. Topography and surface improvements may be shown on the top sheet and geology may be shown on all sheets by conventional signs or cross-hatching, to the extent that it does not interfere with visability of the lower sheets. Veins are shown by red lines and stopes by red cross-hatching. Lettering is best done with a small ruling pen.

Geologic Maps Transferred to Glass

As to geologic mapping, separate level sheets are first traced from the engineer's maps. From these, 8½x11-in. working sheets are traced on unprepared blueprint cloth, which stands water and rough treatment much better than paper. This tracing is done over glass lighted from below, which can be simply accomplished by cutting a hole in the drafting table and setting in a piece of plate glass, about 14x20 in., flush with the top. Two 50-watt Mazda lamps, placed in a reflector box below, will give ample light. Once used, the engineer will wonder how he ever got along without this simple contrivance. These working sheets are used for the underground geologic mapping and are held in a 9x12-in. loose-leaf aluminum holder. The geology is shown in detail with colored pencils and side notes where needed, and is then transferred to the level sheets. When completed these geologic maps of each level are of great value in themselves and are also used in conjunction with the model, on which it was not considered advisable to attempt much geologic detail.

The model has been in constant use since completion, especially in deciphering the somewhat complicated vein systems of Bull Hill. Not only the management, but the leasers as well, spend much time in profitable study of it. The ore discovered through its use has repaid the cost several times over, and it has shown several interesting possibilities which have yet to be tested out.

A duplicate model, but made on a scale of 60 ft. to the inch, was recently asked for by our eastern office. New drawings were necessary for the glass sheets, and a reduction by pantograph was considered with dismay, the engineer being busy with current work. After due consideration, photographic reduction was decided on and carried out with complete success. It is mentioned here because it may solve similar difficulties of other engineers. Each sheet of glass in turn was placed in a vertical wooden frame which had tracing cloth tacked over the back, at a distance of 2 in. from the glass, to diffuse the light. This frame should be flared out inside at the back so that the back inside edge will not be caught by the camera. The camera was placed facing a window having a north light, at a distance of about 16 ft., with the frame on a table about halfway between. Exposure of the forty-two sheets required two and a half hours. Negatives 8x8 in. in size were made and enlarged to 28x28-in. positive prints, thus effecting the desired change of scale. The colors on the glass were all opaque enough to register, and only a little retouching was needed. The accuracy was as great as could have been secured with a pantograph, and the expense, bother, and time required were much less. The work was done by Stewart Bros., professional photographers, of Colorado Springs.

Advantages of Use of Model of Type Described

At many mines, a composite map is all that is needed, but where there are numerous veins, nearly vertical in dip, with extensive deep workings from vertical shafts, a composite becomes such a jumble that even the engineer who made it has difficulty in using it. A glass model, however, presents a picture of the mine in true proportions readily understood by anyone. At most mines, the great problem is to find the ore, and there are many where a model, intelligently used, would be of the greatest assistance. The engineer and geologist cannot find ore where there is none, but, after careful study of a given district, he should be able to point out the most likely places for its occurrence. His theories should be based on the available facts, and revised, if necessary, in accordance with new underground development. No logical plan of development can be formed without a sound theory on which to base it, and the persistant study of a model, with its accompanying geologic maps, kept up to date, will usually result in such a theory. Too much emphasis cannot be laid on the importance of getting the facts, first-hand if possible, before theorizing, and of keeping the faculties of observation undulled by previously formed conceptions.

Acknowledgment is made for co-operation in the planning and preparation of the model to A. F. Carper, superintendent, and A. D. Walker, general foreman; also for efficient help in geologic mapping to Martin Dwyer, and work on the glass to Henry J. Hersey, Jr.

Useful Operating Ideas

Junction of Inclined With Vertical Shaft

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THE San Francisco shaft, one of the old shafts of the Zacatecas district, is vertical down to the 300-meter level, whence it inclines at an angle of 63 deg. from the horizontal, following the dip of the Agripo vein and also its strike, which is at a horizontal angle of 9½ deg. from the vertical section. This shaft was used by the old operators for unwatering the lower levels of the mine. The pump rod of the Cornish pump was found in position when the 300-meter level was reached. A knuckle joint of 16 by 22-in. timber had been placed at the junction of the inclined and vertical shafts, supported by a cantilever beam, thus enabling the pump to be operated in both inclined and vertical sections of the shaft, from the same engine, which was at the surface.

Although some development work is done from this shaft, its main object is to unwater the mine, as it has access to the deepest levels. The shaft throughout its vertical section, though not of a regular cross-section, averages about 12 by 16 ft. In places it has been walled in with masonry. The present collar is located at the 105-meter level, as the upper part has been destroyed by robbing of pillars by former operators. The hoist is located some distance back in a room cut out of the ground for the purpose. Sheaves and dumping device are placed at proper height to allow dumping into a bin for drawing off at the 105-meter level, whence the material is hauled to the General shaft for hoisting to the surface.

Vertical Portion of Shaft Timbered with Steel I-Beams

The vertical portion of the shaft is timbered with 6-in. I-beam wall-plates, the ends of which extend into hitches in the walls and are cemented in place; the dividers consist of 4-in. I-beams laid on top of the wall-plates and secured to them by bolts. No vertical members are used except at shaft stations. Steel timbering was placed in the center, thus enabling the pumps to operate, one on each side, while sinking in the vertical section. The lower, inclined section is timbered with 8 by 8-in. timber wall-plates and end-plates and with 6 by 8-in. dividers; below the junction, the hanging wall-plate is omitted, as the rock is solid and no lagging is required. The center compartment is lined on the foot-wall with 2 by 12-in. boards. As is shown in Fig. 1, the vertical part is really a two-compartment shaft, while the incline has three compartments. The cage goes only as far as the 300-meter level, where the booster pumps are situated.

As the inclined shaft was under water and full of débris and muck, and there were no accurate data as to its dip or strike, the engineers were extremely fortunate in selecting the proper center line for the incline, for it was necessary to cut out about 2 ft. on either end to allow room for the pump compartments. For the entire length down to the present elevation, the 340-meter level, this center line has been maintained with no change. Had the engineers not been so successful in choosing the center line, it might have been

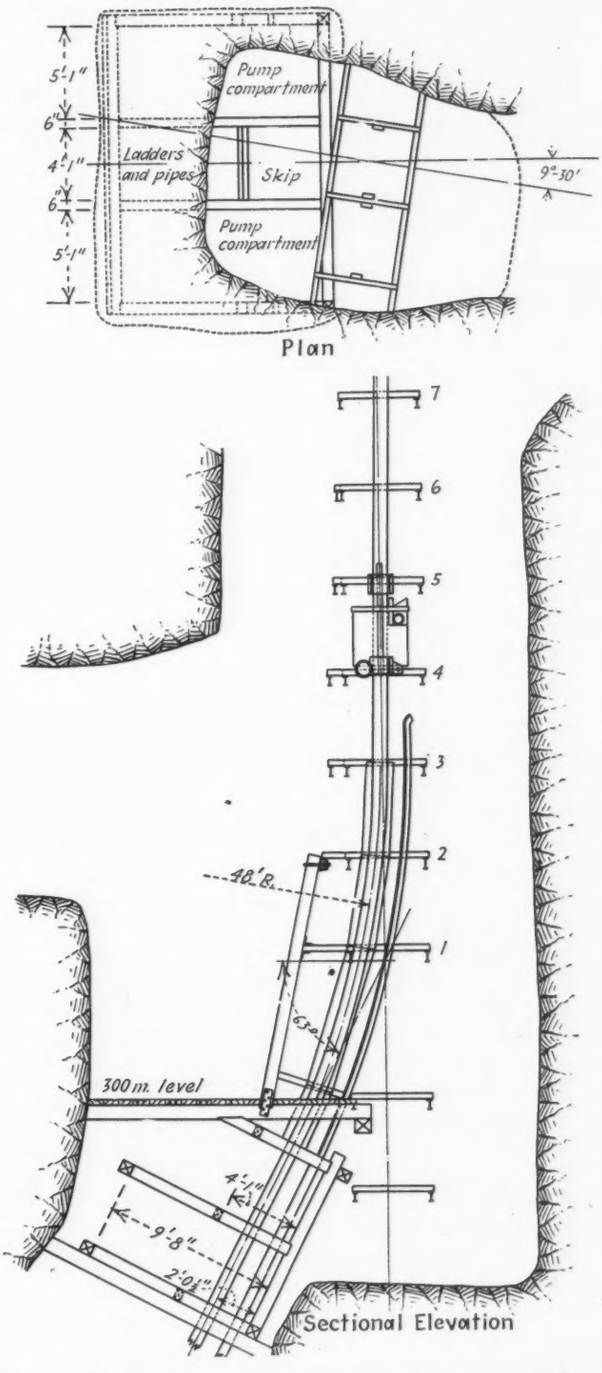

Fig. 1—Vertical cross-section and plan of junction of incline and vertical shaft sections

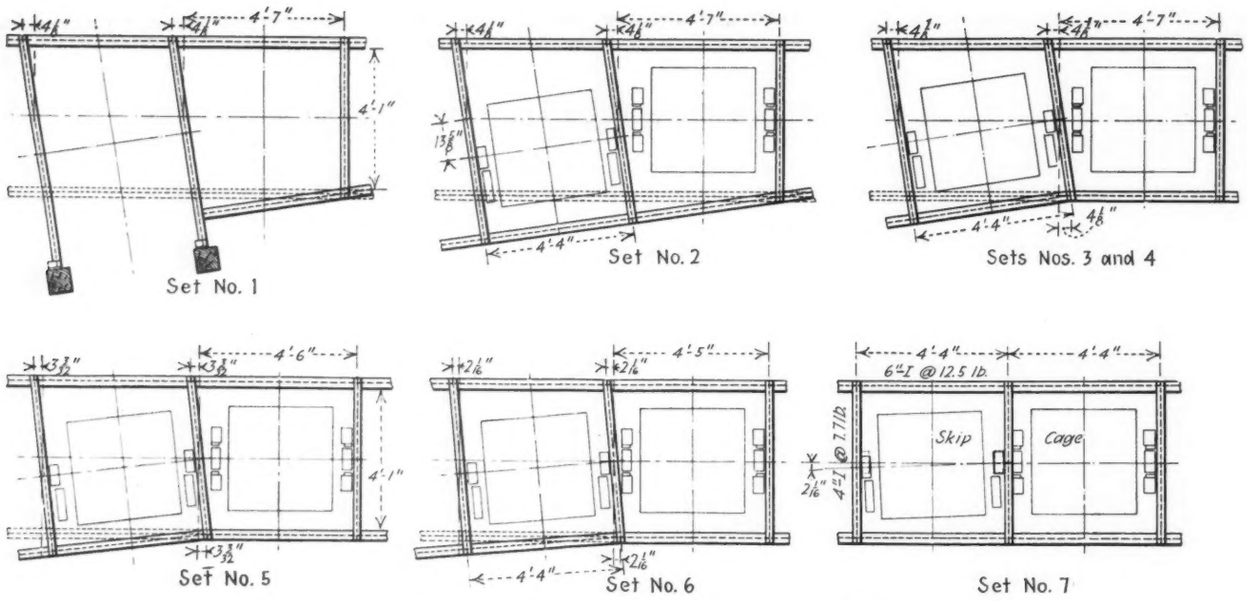

Fig. 2—How the "twist" was adjusted between sets Nos. 1 and 7

necessary to make an offset to one side or the other, thus destroying the perfect alignment. The Cornish pump rod which was encountered at the 300-meter level gave an idea of direction and inclination; also the center line of the shaft.

The manner in which the horizontal angle of 9½ deg. was allowed for is shown in Fig. 2. It was decided that about 2 in. per set was the maximum amount to turn the shaft (the sets are 6 ft. center to center); and as the cageway was to be omitted below the 300-meter level, it was only necessary to change the skip compartment. It was also thought best to bring this compartment normal to the direction of the incline, before starting to incline, so that the curved guides would be at right angles to its strike.

Curved Guides Used

The curved guides are made of well-seasoned Texas pine and are reinforced with, or rather mounted on, ¼-in. steel plates, which are in turn securely bolted to the sets. Difficulty was anticipated in bending the guide nearest the cage, as it is merely twisted, the total distortion being 9½ deg., or 2 deg. 22½ min. per set. However, the guide was readily drawn to place with bolts, and no splitting or splintering resulted. Cage guides and end-plate of cageway were shifted over 1 in. per set, to clear the divider and the safety dogs of the cage. The cuts show how the turn in the shaft was effected, the wall-plate nearest the incline being bent out, the total turn of 9½ deg. being taken care of in four sets. Sets No. 1 and 2 are on the middle of the curve, so that here the dividers were lengthened and the wall-plate in the case of No. 2 was moved out without bending, and on set No. 1 it was omitted in the skipway.

The skip had been used in the vertical shaft and was altered as shown in Fig. 3 by adding a pair of wheels and axle *A*, to take the place of one side of the guide shoe *B* and to act as rollers down the incline. The dumping rollers *C*, in addition to serving their original purpose, serve as a support for the upper part of the skip when in a slanting position. These latter ride on another set of smaller guides made of 4 by 6-in. timber below the junction and of 3 by 3-in. angles curved to follow the curved wooden guides, at the junction itself.

The shaft has been in operation below the 300-meter level for nearly a year, and no trouble has been experienced with it or with the skip since its initial operation.

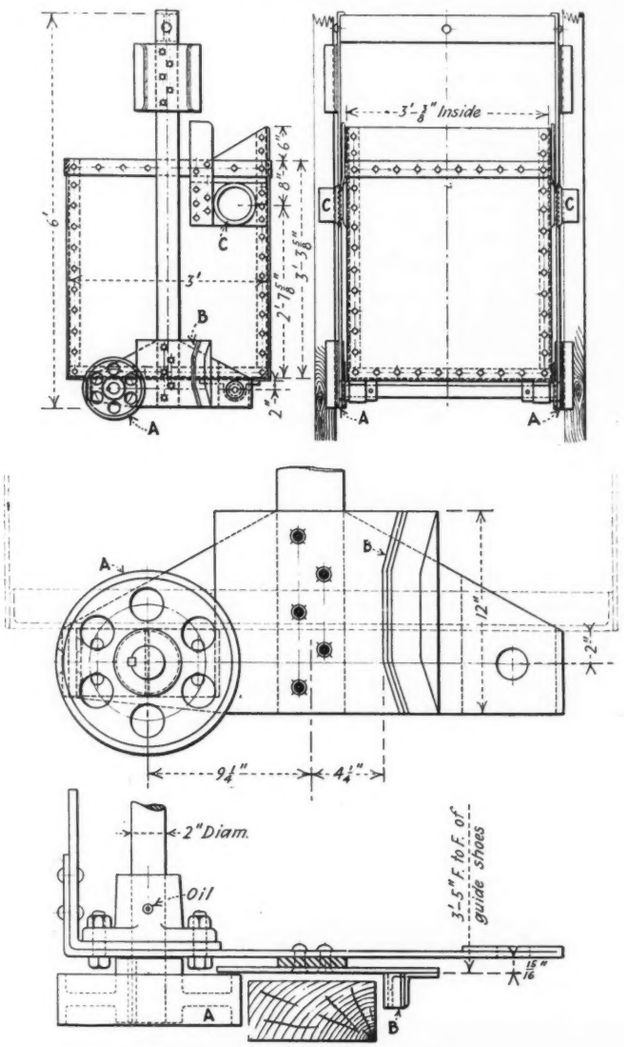

Fig. 3—Details of skip changes

Discussion

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Prospecting With the Magnetometer

THE EDITOR:

Sir—In the issue of Feb. 20, 1926, of the *Engineering and Mining Journal-Press*, King C. Laylander published an article describing the results which he obtained with the magnetic method over placer ground. The title of this article is "Magnetometric Surveying as an Aid in Exploring Placer Ground." The results of the measurements checked closely with the actual geological conditions, and one may understand the interest aroused by this use of magnetic instruments, which is indicated by the numerous inquiries that Mr. Laylander has since received. I thought, therefore, that it might be of interest to readers of the *Engineering and Mining Journal* to hear of the success which has been obtained in other countries with the magnetic method, not only over structures similar to those of placer ground, but also under other geological conditions.

Comparing the results obtained so far with the measurements of Mr. Laylander, it will be possible to give a physical explanation of the magnetic anomalies observed by him. This will indicate the range of application of this method to the mining engineer who is interested in this problem, and thus protect him from mistakes while applying the method and suggest new possibilities for locating mineral deposits.

Dealing briefly with, first, the development of the magnetic method, I shall confine myself to stating what geological conditions have been examined, and when, where, and by whom. Further details may be secured from the selected bibliography given on pages 55-58 of the issue of Jan. 9, 1926.

The first application of magnetic instruments for exploration purposes is, strange to say, older than the knowledge that the geological structure and the earth magnetism are closely related. It is said that in 1760 the dip needle had already been used in mines of New Jersey for finding iron ores. Later it was realized that not only iron ores, but the geological structures generally influence the earth magnetism. This came about through the influence of Gauss, whose theory of the earth magnetic potential computed for an ideal earth required everywhere a straight run of the isomagnetic lines. In 1846 John Locke, in the United States, found that a variation of the earth magnetism was caused by mountains in North America. In 1849 K. Kreil pointed to the fact that the Alps, which represent a great tectonic unit in the European Continent, also influence the run of the magnetic lines. E. Naumann called attention in 1887 to the distorsion of the isogonic lines in Japan by the Fossa Magna, a large faulted volcanic zone. Caspari found in Madagascar heavy disturbances, which are also associated with vulcanism and tectonics, and similarly W. Palazzo in 1892 in Italy. Ruecker and Thorpe in 1890 also showed the relation between the results of their magnetic measurements in the British Isles and the main tectonic features. Eschenhagen noticed in 1898 that the Harz Mountains, in northern Germany, influence the course of the magnetic lines; the measurements of A. Schueck in 1898-1902 indicated a connection between the earth magnetic disturbances and the contours of the shores of the North Sea and the Baltic Sea; G. F. Becker in 1909 stated his belief in the possibility of deriving from the isogonic lines not only a connection with the structure, but even with the main occurrences of oil in the United States. Also, in New Zealand C. C. Farr in 1918 observed a relation of the earth magnetism to the tectonics.

C. A. Heiland

The conformity of geology and earth magnetism is not confined merely to the large, regional main features of the structure, but goes much further. All rocks of different contents of magnetic or magnetizable substance influence the earth magnetism in a different manner. This was shown by the measurements already mentioned by A. W. Ruecker in England in 1890, the measurements of E. Moureaux in the Paris Basin in 1904-1907 and the interpretation which in 1908 and 1913 F. W. Pfaff gave to the measurements of Lamont, Messerschmidt, and others in Bavaria. E. Deecke, in 1906, and A. Tornquist, in 1911, tried to bring in connection the magnetic disturbances in northern Germany with the magnetic properties of the deeper formations. Whether this interpretation is correct has not yet been entirely confirmed. Very extensive measurements were made by O. Goellnitz in Saxony in 1908, 1909, 1910, and 1919, which showed in part excellent conformity between the earth magnetism and the properties of the strata. Similar results were obtained by A. H. Cox in 1918 in Northamptonshire and Leicestershire. In 1920 A. Nippoldt repeated the measurements of Eschenhagen in the Harz Mountains with a sensitive instrument that had recently been devised, the so-called Schmidt's field balance, and obtained data showing close relations of the various geological formations to the magnetic vertical intensity; in 1923 H. Reich used the same instrument in Upper Silesia and observed a remarkable influence of faults.

Igneous rocks usually have a heavy disturbing influence on the earth's magnetic force. Besides Naumann, Palazzo, Eschenhagen, Nippoldt, Becker, and Goellnitz, whose observations in reference to the disturbances

caused by igneous rocks have already been mentioned, the following authors have concerned themselves especially with the strong local influences caused by plutonic rocks on the earth magnetism: M. Zeisberg and O. E. Meyer, in 1899, in the Zobten and the Riesengebirge; W. Schaper, near Meiningen; and K. Haussmann, near Noerdlingen, Germany; Brunhes and David at the Puis de Dome in France; R. v. Eoetvoes in Hungary in 1912; and R. Krahmann, in 1925, near Cassel, in Germany.

Greater disturbances than those caused by igneous rocks but locally more limited are caused by magnetic ore deposits. The most magnetic ore is magnetite; then follows magnetopyrite and hematite, and then limonite. In 1873 measurements above magnetite deposits were made in the United States by Brooks; in 1875 by H. Smock; in 1899 by H. L. Smyth (in Michigan), and in 1915 by Hotchkiss (in Wisconsin). The magnetic method for locating ore deposits was highly developed in Sweden by T. R. Thalén in 1879, Dahlblom in 1898, and Carlheim Gyllenskoeld in 1889, 1907, and 1910. In Russia the measurements of P. Passalsky in 1901 showed heavy disturbances, which were probably also caused by iron ores near Krivoy Rog. The best-known disturbances in that country, however, are the anomalies near Kursk, exceeding many times the normal earth field. In Germany measurements above magnetite deposits in Saxony were made by C. A. Heiland in 1924, and also by A. Wagner above lesser magnetic ores.

Development of Magnetic Theory Began With Application in Iron Mining

Likewise, the development of the theory of the magnetic method began with its application in iron-ore mining. The simplest form of the theory was given by T. R. Thalén in 1879 and improved in 1899 by F. Uhlich and H. L. Smyth, and in 1910 by Carlheim Gyllenskoeld. Further derivations were published by R. Griesser in 1924 and H. Haalck in 1926. The following authors pointed to the frequent conformity of magnetic and gravity disturbances: I. B. Messerschmitt, in 1901; Platania, in 1904; W. Deecke, in 1906; A. Ricco, in 1908; R. v. Eoetvoes, in 1912; and P. P. Lasareff, in 1923.

Perhaps it will interest some to learn that it is possible also to locate salt domes with magnetic instruments—that is, with sensitive ones. Such measurements were made by F. Schuh in Mecklenburg, Germany, in 1920; further observations were published by C. A. Heiland in 1922 relating to anomalies above the salt domes near Segeberg (Holstein), Lueneburg (Hannover), and Bahlburg (Hannover), and by H. Haalck and G. Brinkmeier relating to the salt deposits near Wefensleben (Hannover) in 1923.

We shall proceed now to describe the results of measurements obtained in areas with geological conditions similar to those mentioned above, in which Mr. Laylander made his observations. These measurements were made without exception in territories covered with glacial drift. The principal results seem to indicate especially that two kinds of glacial sediments are acting opposite to each other. The first kind is represented by the direct deposit of the ground moraine of the glaciers, carrying all sizes of igneous (mostly) boulders, called "till." Above glacial drift of this kind generally an increase of earth magnetic values has been observed. The second kind is the sands which have been deposited by the rapidly flowing waters of the melting glacier ice —that is, glacio-fluvial sediments, which are low- or non-magnetic. The geophysicists therefore are more and more inclined to abandon the interpretation, which W. Deecke and A. Tornquist attributed to the peculiar magnetic disturbances in the North German plain, especially to those in East and West Prussia, and to explain them as caused by alteration in thickness and petrological properties of the glacial drift because of their rapid local changes. According to Pfaff, in 1914, a similar interpretation is probable for the changeable magnetic conditions of the glaciated foreland of the Alps. Measurements above the glacial drift of the North German plain have been made, especially by H. Moll in 1922, and F. Schuh in 1923, who found in accordance with the above remarks comparatively high values above glacial sediments, but in places where Cretaceous chalk and Tertiary sands came nearer to the surface, a decrease of the magnetic vertical intensity. A. Nippoldt in 1924 and F. Errulat in 1925 could find a direct connection between the thickness of the till and the values of the magnetic vertical intensity. Above the glacio-fluvial sands which were deposited by ancient streams in the glacial period, Rijckevorsel observed in 1895 in Holland a decrease of the magnetic values. This was also observed in 1922 by C. A. Heiland near Hamburg. The publication of A. Gibson mentioned by K. C. Laylander is not at my disposal at present; the results obtained by him, however, seem to be similar to those published in 1895.

The geological conditions over which the measurements in Germany and Holland referred to were conducted are similar to those described by Mr. Laylander, and an attempt may be made to interpret his results with their aid. Then it will be possible to decide under what geological conditions of placer ground the magnetic method can be successfully applied. The interpretation of Mr. Laylander's measurements, however, is rendered difficult because, with the exception of his Fig. 5, it is not stated in his article whether the magnetic anomaly was positive or negative, or what component of the earth magnetic field was measured and how much the deflections observed amounted to in absolute units; besides, there seems to be a disagreement between Fig. 5 and Fig. 6. Likewise, it is nowhere stated, unfortunately, what the petrological properties of the bedrocks were.

Magnetic Substances in Bedrock and Placer Must Differ in Quantity

It must be pointed out that the first stipulation for exploring placer ground by magnetic methods is that there must be differences in the contents of the magnetic substances in the bedrock and in the placer deposit. The difference in the metal contents only, as Mr. Laylander implies, is of no influence; the metal particles must be magnetizable and must be distributed differently in bedrock and placer. That means practically that placer ground can be found with magnetic methods only in case either placer or bedrock contains magnetite. Furthermore, this means that magnetic measurements can give information about the amount of ore concentration only in case the placer contains magnetite, and cannot give such information if the placer contains no magnetite. Therefore, in Mr. Laylander's measurements a relation of values (commercial values of the gold-bearing sands) to the magnetic anomaly exists only at Quesnel River (Figs. 5 and 6), where the placer carried magnetite; this conformity apparently did not

show on the properties of the Metals Exploration Co. in California (Fig. 7), where probably no magnetite existed.

I gain from Mr. Laylander's measurements the impression that he observed the magnetic vertical component because, according to his statement, the maximum disturbance is generally vertically above the mineral. This is the case with iron-bearing bodies magnetized by the induction of the earth magnetic field in the latitudes where Mr. Laylander made his measurements; whereas the horizontal component is generally on its maximum and minimum above the edges of disturbing bodies (this relation is reversed in territories with smaller inclination). Furthermore, it seems to follow from his measurements that the disturbances above the placer near Keithley Creek and Cedar Creek were negative, but positive near Quesnel River, as shown in Fig. 5. If these assumptions are right, it is possible to explain the results of Mr. Laylander without difficulty by differences in magnetization, and it is not necessary to assume, as Mr. Laylander tries to do, that electric currents are the cause. The latter could be the case only if the vertical intensity were at its maximum and minimum near the edges of the channels and the horizontal intensity at its maximum or minimum directly above the metal-bearing gravels; that is, if the observed values were actually values of the horizontal intensity. It must be emphasized, however, that there are certain indications that a magnetic local anomaly can be caused by earth currents, but this has not yet been proved conclusively. In 1922 I found near Hamburg above a glacial valley (that is under conditions similar to those of the placer channel) a minimum and a maximum of the vertical intensity very close together which had to be explained as caused by an earth current, because no other explanation was available; the earth current was proved later to be variable.[1]

Preferring, therefore, an interpretation of Mr. Laylander's results which is based on different magnetization, because it is simpler, we get for the measurements near Keithley Creek the following relation: The bedrock country rock consists of more magnetizable rocks, probably igneous rocks, which are lying at a distance from the earth's surface at the bottom of the channels, which are filled with low-magnetic or non-magnetic material. Therefore, the amount of the magnetic vertical intensity decreases above the channels. Similar conditions seem to exist near Cedar Creek and probably also on the property of the Metals Exploration Co. in California. Unfortunately, Fig. 7 does not give any information concerning geological and petrological properties nor about the absolute amount and direction of the measured anomalies.

Just the reversed case comes true near Quesnel River. It results from the decrease of the magnetic anomaly over the rim rock, which is low-magnetic. The clay residuum of the valley is somewhat more strongly magnetic, and is covered by the strong-magnetic, metal-bearing gravels. Therefore only in this case could a relation be shown between the magnetic anomaly and the commercial values, as naturally and for geologic reasons an enrichment of magnetic substances is likely to coincide with an enrichment of precious metals.

For the application of magnetic methods to the exploration of placer ground success can be predicted only if the placer carries less magnetite or more magnetite than the country rock. If neither country rock nor placer contain magnetite, there can be no hope of finding placer ground by magnetic methods.

Houston, Tex. C. A. HEILAND.

[1]H. Haalck (*Zeitschrift fuer Geophysik* 1926, p. 3) is of the opinion that the strength of this earth-current would be too great. However, this is not the case in the opinion of Ad. Schmidt, of Potsdam, who computed the amount of the current from the magnetic measurements.

Geologic Features of Bolivian Tin-Bearing Veins

THE EDITOR:

Sir—I have read with great interest Mr. Koeberlin's valuable article on the Bolivian tin veins, and as he invites comment on his ideas regarding secondary enrichment I have certain observations to make on the subject. In the first place, I have noticed ore occurrences which apparently support the contention that secondary enrichment has taken place in certain cases. In the Quimza Cruz district there are numerous small veins about five inches in width, which are extremely rich—up to 30 per cent tin—within a few feet of the surface. This high-grade ore never persists, and usually disappears within ten or twenty feet, both on the strike and the dip. To explain this enrichment by mechanical means—namely, the solution of the pyrite and the migration of the tin—is not practical, as the ore is not oxidized, and it carries pyrite. In this district erosion has been so rapid that oxidation has not kept pace with it, so that this type of ore is today visible at the surface. It may be that the high-grade ore which we find now under these conditions is the remaining portion of the enriched zone, most of which has been eroded.

As regards copper minerals being responsible for this enrichment, Mr. Koeberlin produces evidence both for and against, and in this Quimza Cruz district there is an absence of these minerals. In the Cornish mines, as is well known, many of the veins have been worked for copper from the outcrop, but, as far as I am aware, no difference has been observed in the grade of the tin ore in the supergene and hypogene zones.

The explanation of the enrichment of Bolivian ores may possibly be found along the following lines: The soil of the altiplane contains a considerable quantity of salt and saltpeter, and presumably there is a certain amount of iodine in the nitrate. It is conceivable that in past ages the tin mineral has been acted upon in such a manner as to form stannous chloride, and this has been oxidized by the iodine. There are probably objections to such a theory of which I, being a miner, am not aware, but the idea is offered for what it is worth, and chemical research in this direction might throw unexpected light on the subject. O. M. BROWN.

Eucaliptus, Bolivia.

Sealing Joint Between Cap and Fuse

THE EDITOR:

Sir—On page 851 of your issue of May 22, 1926, I read an article on sealing the joint between the cap and fuse. Without commenting on the different articles used, I recommend that beeswax be used—a pure beeswax heated enough to be easily applied with the end of the fuse kept free of the wax. Seal the edge of the cap with the fuse on the outside, then place it in the cartridge of dynamite, and it is ready to go into a hole with water. This is the best that I have found in sixty-three years of mining. P. B. CHISEM.

Guaymas, Mexico.

News of the Week

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Summary

ZINC INDUSTRY in Poland increases production; Harriman-Anaconda contract ratified by new Polish Government.

Metaline district, Washington, has new lease of life due to saving zinc as a byproduct; small mines making shipments.

Cusi Mexicana and San Miguel mining companies merge—Miner arrested at Bisbee for high-grading.

Boy Scouts taught rudiments of prospecting and mining; locate claims and perform assessment work.

Western quicksilver mines increasing production—Western Lead suit thrown out of court.

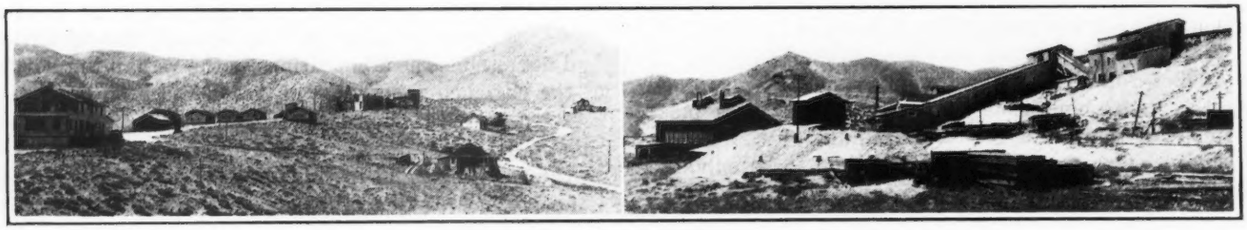
Suction dredges in Malayan tin mines replaced by bucket dredges—Much prospecting for tin—Golden Horseshoe mine, Western Australia, closed.

U. S. gold production less than $50,000,000 in 1925—Utah-Apex reduces dividend—Tonopah Belmont mill ready soon.

Tonopah Canadian Mines drifts 512 ft. with one machine in thirty days—Quincy mine obtains good results at regrinding plant.

Government to spend $100,000 per year to develop potash deposits.

South African platinum returns encouraging.



Mason Valley Mines Co. office (left) Bluestone Mill (right)

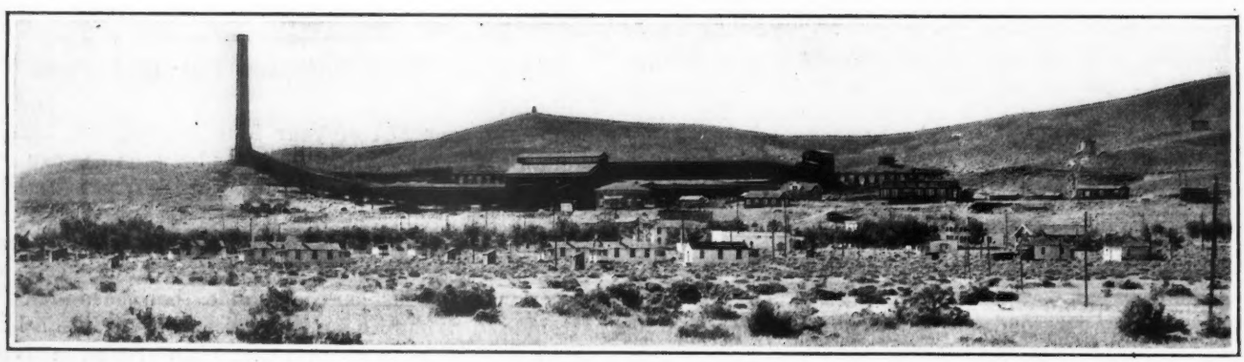
Mason Valley Mines Now Producing

The Mason Valley mine and the Bluestone mine and also the Bluestone mill, in Nevada, are now in operation, the high-grade ore and concentrates being shipped to Thompson, Nev., for storage in the smelter yards and bins. The smelter will probably start within the next month. Ore in the Mason Valley mine has been followed from the surface to the 570 level, averaging in the neighborhood of 3 per cent copper. The Bluestone mine has attained a depth of 540 ft., but ore is mined above the 300 level. Production to date has been about 500,000 tons of 2½ per cent ore.

The ore is transported from the mines by electric motors, discharging the ore into a 600-ton ore bin at the Bluestone mill, where flotation equipment consists of fifteen Janney mechanical air flotation machines, four batteries made up each of three primary cells, and eight secondary cells. (Callow cell flotation equipment).

The Mason Valley Mines Co. owns the broad-gage railroad extending from the mill to the tracks of the Nevada Copper Belt R.R. at Mason, Nev., a distance of 2¾ miles. The maximum grade is 7 per cent and the motive power is a 47-ton Heisler locomotive. Transportation to the smelter at Thompson, 12 miles, is by the N.C.B. railroad.

Thompson is well equipped with housing facilities, with club house, ball park, large shade trees, and neatly painted houses, situated within easy walking distance to the smelter. The plant consists of a complete sampling mill, bedding bins, and the latest-type scale hoppers, and is equipped throughout for electric haulage. There are two blast furnaces, one 56 in. x 30 ft. and one 45 in. x 35 ft.



Mason Valley Smelter at Thompson, Nev.

Revival of Metaline District of Washington

Early Mills Not Successful; Zinc, Once a Detriment, Now a Profitable Byproduct

By R. G. MacPhee
Spokane, Wash.

FOR several years there has been a great deal of activity in the Metaline district, northeast of Spokane, Wash. Several properties, including the Grandview, Bella May, Z Canyon, Blue Bucket, Diamond R, and Oriole, have been shipping more or less regularly to the Bunker Hill plant at Bradley, Idaho. The shipments for the most part have been crude ore containing values in gold, silver, zinc and lead, with the main values in lead and zinc. The separation of the lead and zinc values is the problem of the district. This mining district is one of the oldest in the Pacific Northwest, as more than forty years have passed since prospectors first entered, staked out their claims, and began to gopher into the hills.

The ore deposits appear to be similar to the Gladstone and Electric Point mines, which are 20 miles to the west over a range of hills. The lead is in limestone, and though uncertain in extent, is rich when uncovered. There are also big showings of disseminated zinc ores, and during the war period one of the zinc properties of the district, the Josephine, was operated with good results. Mills installed by the Diamond R and the Oriole did not solve the metallurgical problem presented by the complexity of the ores, and this, too, had a depressing effect. If proper preliminary experimental work had been done, the mills might have been made successful.

Transportation Facilities Good

The most feasible route when the camp was first opened was to take the Northern Pacific to Rathdrum, Idaho, and from there drive by team to Albany Falls, on the Pend Oreille River. From there it was necessary to take a boat 60 miles down the stream to Box Canyon. Here a portage of boat and supplies had to be made, after which another row of five miles brought the prospectors to the old camp of Metaline.

It is now possible to reach the district in a few hours by automobile from Spokane, using the new highway which connects Spokane with Nelson, B. C. The region is also served by a branch of the Chicago, Milwaukee & St. Paul.

The district is now considered an important factor in the development of eastern Washington, because, aside from it mineral possibilities, the Box Canyon of the Pend Oreille River is the key to the Columbia basin irrigation project, which is to reclaim the arid lands of Washington. At Box Canyon it is proposed to construct a dam to divert the waters of the Pend Oreille River. From this point the water will be carried by a canal and huge pipe lines to the district south and west of Spokane that it is the plan to reclaim. The project calls for nearly 17 miles of tunnels and several large reservoirs, including a lake west of Spokane's city limits. An expenditure of about $175,000,000 will be necessary.

Recent development at the Grandview and Z Canyon mines has been more encouraging. The Z Canyon was only discovered in August, 1925, and is already yielding ore. It is located one mile south of the international boundary line and 15 miles north of the town of Metaline Falls. According to William Schierding, of Spokane, a former operator of the Coeur d'Alenes, who is in charge, the ore on the Z Canyon has an outcrop of 400 ft. and is from 5 to 15 ft. in width. Schierding has developed the vein to a depth of 60 ft. and is now installing a compressor and other machinery. He has the property under a lease and bond for five years on a 15 per cent royalty basis.

The Grandview mine has been operating on a more elaborate scale, and last year built a 35-ton concentrator to handle the silver-lead-zinc ores blocked out. Values are mostly lead, and it is said that the concentrator is making a satisfactory separation and saving. An accident to the power line caused the property to close down during February and part of March. Operations were resumed on March 25 and a car of concentrates and also a car of high-grade has since been shipped.

The Bella May mine in recent years has probably been more of a regular shipper than any other mine of the district. Control of this property is in the hands of John Sawbridge, of Yakima, Wash., who has also been successful in developing the Sunshine mine, in the Coeur d'Alene district, until it is now nearing the dividend-paying stage. The ore in the Bella May is lead, with very small silver values, and is found in large pockets in a limestone formation somewhat similar to the formations found in the Electric Point and Gladstone mines to the west in the Leadpoint district. Returns from hand-sorted crude ore shipped from the Bella May have netted the operators as high as $3,000 for a 30-ton car.

Zinc Industry in Poland Increasing Production

Largely as a result of declining production costs due to the depreciation of the zloty, the production of raw zinc and zinc ore in Poland is rising. Zinc ore production in March amounted to 105,163 metric tons in comparison with 94,062 tons as a monthly average for 1925. Raw zinc produced in March of the present year came to 10,451 tons, compared with a monthly average of 9,528 in 1925.

Plans are being made for the establishment of a sales syndicate for the finishing branch of the Polish zinc industry. Headquarters will probably be in Cracow.

Dispatches announce that an agreement has been reached between the new Polish Government and the W. A. Harriman-Anaconda Copper Mining interests for the sale of the von Giesche zinc mining properties in Upper Silesia to the Americans.

Previous reports from Warsaw had suggested the possibility of the withdrawal of the Harriman-Anaconda offer. The American interests were represented as insisting upon immediate approval, without reservation, of the agreement signed by the interim Cabinet during the recent coup d'état. The present Cabinet was reported to have declined to acknowledge the action of its predecessor.

Cusi Mexicana and San Miguel Mining Companies Merge

With the merger of the San Miguel Mining Co. and the Cusi Mexicana Mining Co. at Cusihuiriachic, Chihuahua, Mexico, completed, preparations are being made to increase the capacity of the mill, install selective flotation, and to explore the large block of virgin ground in the old Santa Marina mine. W. G. Swart, vice-president and general manager of Mesabi Iron Co., Babbitt, Minn., has become consulting engineer to the Cusi Mexicana Mining Co. H. C. Dudley, president, did not organize either of these companies, but he acquired control of the San Miguel some time ago when it was in financial straits, and by buying into the Cusi Mexicana Mining Co., on whose property the San Miguel Co. had a lease, he was able to merge the two companies, which was necessary before any real exploration campaign could be initiated. The new board and the officers are mainly of Lake Superior men.

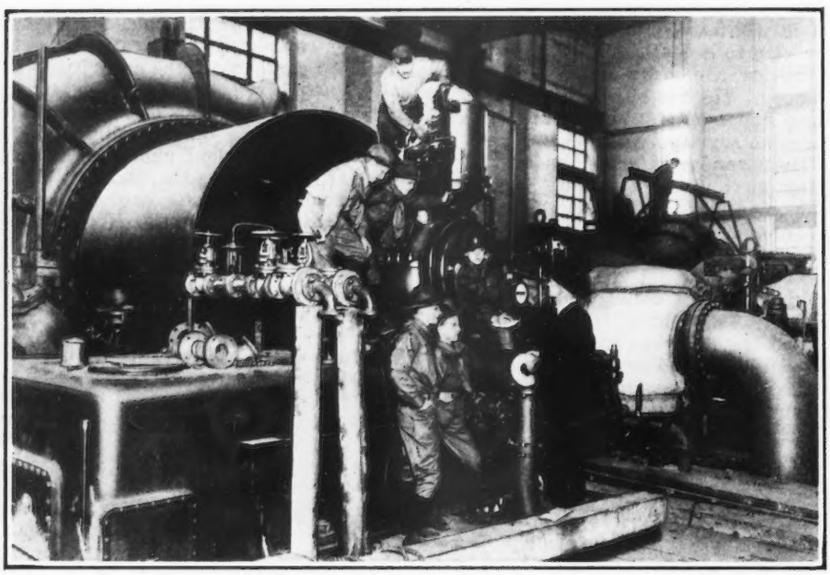
A 150-ton flotation mill was recently completed and is operating at a profit. The company is now planning the installation of more power, to increase the mill capacity and to develop the mine. There seems to be enough good milling ore in sight to run the present mill for two or three years, and, further, a chance to get large orebodies, possibly similar to the bonanzas of the upper levels of the Santa Marina and San Antonio mines.

Miner Arrested for High-Grading in Bisbee District

A revival of old Cripple Creek days is taking place at the copper camps in Arizona. Recently a man was arrested for high-grading rich gold ore in the Shattuck mine, Bisbee, Ariz. Occasionally rich streaks of gold are encountered in the mines of the Bisbee district. Years ago the Reed lease, which is in the Uncle Sam Division of the Copper Queen, became temporarily famous for its gold production. This was followed by numerous smaller gold occurrences in the mines of both the Copper Queen and Calumet & Arizona companies, and now the Shattuck-Denn company has opened up an erratic streak of this character. The ore which the miner had cached away and was attempting to high-grade consisted of very fine specimens of altered limestone, thickly peppered with gold, of which a powder box full might easily run into several hundred dollars.

Goldroad Mine Under New Management

Jack Shank, who operates the Shank-Schmidt lease in the Aztec mine of the Tom Reed estate at Oatman, Ariz., has acquired the Goldroad mine, in the same district, under a lease and bond agreement with the U. S. S. R. & M. Co., present owner of the mine. Available records show that about $10,000,000 in gold ore has been produced from the Goldroad mine in the last fifteen years. After acquiring the mine in 1916 the U. S. company operated it a short time, when it was closed down on account of the war. It was reopened in 1922, but was again closed down in 1924. The property includes eleven patented claims, on which there are three shafts, two of which are equipped for operation.



Boy Scout "engineers" inspect mining plant

The surface plant includes a 300-ton mill and 150 other buildings. It is said that there is considerable $14 ore opened up. Mr. Shank and his associates, the Onetto Brothers, expect to overhaul and refit the mill to provide for a capacity of 100 tons per day, and begin production in three months. Mr. Shank has also obtained a two-year lease on the Big Jim mine.

Municipal Engineers Win Salary Increase as Result of Strike

After an all night stormy meeting of the Chicago City Council, the strike of engineers and technical employees of several municipal departments was announced as settled when the aldermen voted an appropriation of $75,000 to grant the engineers the 30 per cent increase in salaries which they demanded. The majority of salaries had been about $300 per month, with a few as high as $600.

The strike, which affected public works of an aggregate cost of $10,000,000, was the first walk-out of the kind among the professional engineering employees of the city, and included the technical staffs of the Health, Building and Public Works departments.

Boy Scout Miners Locate Claims

Boy Scout Troop No. 1, Wallace, Idaho, recently located two mining claims, the "Lucky Scout" and the "Good Turn." The scouts decided that "learning by doing" applied in their case, particularly to mining, as their fathers worked in the mines and their scoutmaster was a mining operator. In April they started out to locate a claim. They found a vein and traced it, staked out two locations, and posted the discovery on each. To obtain these claims the scouts are required by law to do work that represents $100 a year on each claim. The boys have refitted an old cabin for headquarters, so that they may be near their mines. Visions of wealth dance before them on their daily hikes. They plan to give $50,000 for a community center in Wallace when they strike it rich.

Not all boy scouts are able to put their energy to such practical use, but several hundred of them do qualify for a merit badge in mining each year. To win this badge a scout must be able to identify and describe twenty-five minerals; define vein, placer, lode, stratum, dip, strike, joint, fault; identify ten different kinds of rocks; state what metals are mined from placers; state in what general respects placer mining differs from lode or vein mining; describe how mines are ventilated; give the conditions that differentiate coal mining from metal mining; and describe systems for mine ventilation, safety devices, and rescue methods as taught by the American Red Cross.

Number of Claims Recorded in Red Lake Division, 5,500

The total number of claims so far recorded in the Red Lake mining division of northern Ontario is approximately 5,500. Of these 4,850 are in the old Red Lake division, which comprises the Red Lake-Trout Lake districts; 415 are in the Woman Lake area, and 241 at Birch Lake.

Copper Ore Discovered in New Brunswick

A comparatively high-grade copper ore has been reported from recent prospecting near Elgin, Albert County, New Brunswick, the preliminary examination covering an area of approximately two square miles, as reported to the U. S. Department of Commerce. According to official assays the ore value runs as high as $15 per ton. Shafts have been sunk over the prospected area and copper ore discovered in every instance.

This discovery has rearoused a certain amount of public interest in a former copper discovery at Scotch Settlement, Kings County, north of Belle Isle. A number of years ago two experienced miners struck good ore at bedrock at a dozen places. Two or three carloads of ore were shipped to the United States, records showing this ore to have had a copper content of 10.09 per cent and 1.19 oz. of silver to the ton.

Steel Mill for Pulaski, Va.

Negotiations between Mayor E. W. Calfee, of Pulaski, Va., and Robert E. Baker and associates, of Cleveland, Ohio, have secured for Pulaski a large steel plate and structural-steel fabricating shop, including the manufacture of electrically operated steel cars. A three and one-half acre site for the new plant has been secured from the Bertha Mineral Co. Building operations will be started just as soon as the contract can be let. The plant will start operating early in the fall, with 100 men, most of whom will be skilled mechanics.

Probing Mining Expenditures of Lewis, Gilman & Moore

In bankruptcy proceedings in connection with various promotions of E. G. Lewis, founder of the Atascadero Colony in California, the referee in bankruptcy is seeking to learn the disposition of $1,113,000 which is listed as a liability credited to one of his eighteen subsidiaries, the mining company of Lewis, Gilman & Moore. According to local reports of the proceedings, Charles E. Gilman testified that the firm had been interested in seven projects, the Greenhorn, Carlotta, National Graphite, Fort Wayne, Omega, Golconda, and Firnegan mines, a total of only $200,000 being spent. The firm is now defunct. It ceased operations about four years ago after the ventures had proved unsuccessful. What became of the difference between $1,113,000 and the $200,000 is being investigated.

"Big O'Brien Mine," Now Known as "Gold Bar," to Be Reopened

The "Big O'Brien Mine," formerly the property of the late F. X. O'Brien, of Wickenburg, Ariz., and now owned by J. A. Twitchell, of New York City, is to be reopened and put in condition for production, according to recent advices. Mr. Twitchell recently visited the property and has concluded to continue work where it was left off some years ago. Operations will be resumed at the new 750-ft. vertical working shaft.

North Star Installs All-Steel Mill on Idaho Group

A new all-steel concentrating plant, which will be operated on the selective-flotation principle, has been purchased by the North Star Mining Co., Oatman, Ariz., for the Idaho property in the Oro Blanco district of Santa Cruz County, Ariz. Its equipment will include a Marcy ball mill, Dodge-type crusher, K. and K. flotation machine, Dorr classifier, and Wilfley tables. The plant will have a daily capacity of 40 tons. Three products are to be obtained—lead concentrate, zinc concentrate, and a combination of silver, gold, and copper. The Idaho group comprises seven claims and is an old producer. Since being taken over by the North Star company a year ago the mine has been completely re-equipped for operation. Much of the machinery was brought from the company's Oatman property. The North Star company has also improved the road to Arivaca.

U. S. Production of Gold Less than $50,000,000 in 1925

The Bureau of the Mint, with the cooperation of the U. S. Bureau of Mines, says the final estimate of refinery production of gold and silver in the United States during the calendar year 1925 was: Gold, 2,411,387 oz., or $49,860,200; silver, 66,155,424 oz., or $45,911,864, with silver valued at 69.44c. per ounce. Production of gold for 1925 was less than that of 1924 by $2,416,800; the year of greatest gold production was 1915, when $101,035,700 was produced. The silver production of 1925 exceeded that of 1924 by about 748,000 oz.; 1915 was also the year of greatest silver output, 74,961,075 oz. having been produced that year.

Cobalt Contact's New Mill Now in Operation

The new 100-ton mill of the Cobalt Contact mine, Cobalt, Ontario, has been put in operation and is now treating 50 tons per day. A flotation unit, which was rendered necessary by the presence of considerable argentite and ruby silver in the ore, is not yet completed, but will soon be in operation. It is stated that enough ore is in sight to keep the mill in steady operation for one year. The principal work at the present time is on the Green Meehan property, where crosscutting is being carried on to cut veins which appear on the surface about 300 ft. from the shaft. Good ore is being taken from the 100 and 250 levels.

Pleasant Creek Mining Claims Pass to New Owners

The Pleasant Creek Mining Corporation, capalized at $3,000,000, with head office at Detroit, Mich., and an operating office at Rouge River, Oregon, has taken over the property of the Pleasant Creek Mining Association, consisting of eighty-three lode mining claims 16 miles north of Gold Hill. The area covered is a granite deposit which contains gold and platinum. Development work has been carried on since 1916 at an expense of $100,000. Many veins of quartz and rhyolite have been cut which contain gold, but the granite incasing these veins gives better values in gold and platinoids.

The mining company is made up and financed by wealthy Pontiac and Detroit, Mich., people, with Dr. Hershell C. Parker, vice-president and consulting engineer, and James E. Ryno, engineer in charge, both with headquarters at Rogue River, Ore. The property is well timbered and watered. A twenty-five-ton modern rod mill, 45-hp. gas engine, and flotation equipment is installed to test Dr. Parkers' system of recovery. A permanent plant will be installed in 100-ton units, until 1,000 tons' daily capacity is installed, with central power plant to drive all machinery with electricity.

Last Chance Mine to Begin Shipment Soon

Charles P. Robbins, of Spokane, expects to have the Last Chance mine, at Republic, Ferry County, Wash., unwatered early in July, and will then begin taking out ore to supply a 20,000-ton contract with the Consolidated Mining & Smelting Co. of Canada, which desires the ore in its smelter at Trail. The ore will be shipped under the contract at the rate of 1,000 tons a month, which is all the smelter will handle. It is a siliceous ore carrying about $9 to the ton in gold.

Tonopah Belmont Mill Ready Soon

Construction work is being rushed by the Tonopah Belmont Development Co. on its properties at Hamilton, Nev. Machinery is being installed and building started for a 9,200-ft. bucket tramway connecting the Cornell tunnel with the fifty-ton concentration plant. Development in the Nevada group has been suspended to center operations on driving the Cornell tunnel 600 ft. to connect with the orebodies opened up in the Nevada at the 250-ft. level of the winze. By Aug. 1, the date when the mill will be completed, the tunnel should reach its objective.

The ore opened up in the mine consists of an oxidized silver-lead material in a series of more or less parallel veins in quartzite. The product is so friable that not much crushing will be needed. A trommel screen will be used to separate the fine from the coarse material, the fines passing direct to concentrating tables. Tailings will be sulphidized and treated by flotation. Mine ore will run from three to five ounces of silver to the ton and 8 to 12 per cent lead. Three large dumps on the Cornell group are to be milled.

By the middle of August, the New Alto Mining Co., Cherry Creek, Nev., will reach the Exchequer vein, where officials believe the downward continuation of deposits in the upper levels will be exposed. In the meantime the company is shipping an excellent grade of ore from the Star and the Gray Eagle mines. The Alto company owns a lease and option to purchase the Star, Gray Eagle, Exchequer, and Imperial mines.

Promising Prospects Near Hole River, Manitoba

At the Betty claims, in central Manitoba, about 13 miles from the mouth of the Hole River, a series of veins with a width varying from 25 to 40 ft. has been traced over a distance of 9,000 ft., carrying gold, copper and silver. Work has been begun on a shaft, and a mining crew will be employed during the summer.

Diamond drilling on the Sherritt-Madole copper-gold-zinc property at Cold Lake, Manitoba, has met with highly satisfactory results. An orebody has been traced for two miles, with a width varying from 15 to 20 ft. Eight holes have been drilled, the deepest going down 300 ft. The property is under option to David Fasken, of Toronto, and E. P. Earle, of New York, who have undertaken to do 5,000 ft. of diamond drilling at a cost of $50,000.

New Production Record for Union Minière

According to the U. S. Department of Commerce the preliminary returns from the Union Minière, which have just become available, indicate that the Katanga mines made new production records in 1925. According to these figures the Congo can claim the leading position among world producers of radium and cobalt and third as a supplier of copper and diamonds. Copper production for 1925 totaled 90,000 tons, an increase of 32,114 over 1923. The output of tin ore reached 15,000 tons, diamonds 88,000 carats, gold 3,800 kg., cobalt 300 tons, and radium 20 grams.

Utah-Apex Reduces Dividend

Directors of the Utah-Apex Mining Co. have reduced the quarterly dividend rate from 35c. a share to 25c. The third quarterly dividend of $132,050, or 25c. a share for the current year, will be paid on July 15 to stock of record on July 3, bringing the grand total of disbursements up to approximately $3,042,000. This reduction has been decided on in order to pay for the construction of the new $300,000 mill from earnings. A decrease in the assay value of the mill heads was also another factor. Although the company has $1,200,000 in cash and government bonds, the management felt that it would be a mistake to use any of this money to pay dividends.

White-Delf First Shipment Returns $60 per Ton

O. C. Nordquist has a contract to drive a 200-ft. tunnel in the White-Delf property, at Clarksfork, Bonner County, Idaho. The tunnel will follow the vein and attain a depth of approximately 175 ft. A trial shipment of galena from the surface is reported to have returned $60 to the ton.

The property is traversed by three veins 200 ft. apart. The largest, 20 ft. wide, is said to have perfect walls, and it is here the work is being done. Compton I. White, of Clarksfork, and associates are the owners.

News From Washington

By PAUL WOOTON
Special Correspondent

Potash Deposits to Be Tested by Government; $100,000 Available Annually for Five Years—Mines Bureau Desirous of Assisting Industry

AT LEAST four core-drill holes will be put down by the government during the next twelve months in an effort to locate potash deposits of commercial size. The legislation which made this possible was put through during the closing weeks of the last session of Congress. Both houses passed and the President approved a five-year prospecting program, for which the federal treasury will provide $100,000 annually. It is fully expected, however, that this sum will be augmented by contributions from interested localities.

The law provides that the money is to be expended under an agreement between the Secretary of Commerce and the Secretary of the Interior. An agreement has been reached which provides that the drilling is to be done by the Bureau of Mines at the points where the Geological Survey will indicate that geological conditions are most favorable for the appearance of potash.

Every effort will be made to hold down the overhead expenses in connection with this work. With the idea of getting the maximum possible amount of the money into the ground, the committee limited to $6,000 the amount which may be spent in Washington. Little if any additional field work will be necessary, it is believed, as the Geological Survey already has gathered sufficient data from which to indicate the places where conditions are most favorable for drilling. Great local interest is being manifested in the points to be selected. If everything else is equal the drilling probably will be done at the localities offering the largest amount of contribution to the fund.

Though the act limits the drilling to the salt-bed area, opportunity will be presented to watch for the occurence of magnesium and sodium salts, as well as those of potassium.

Commodity Divisions in Bureau of Mines

The function of the proposed commodity division of the Bureau of Mines would be to act primarily for the department in the promotion of commerce in the industry it represents. To do this the division would endeavor to be the center of information, particularly as to markets and sources of supply, and would develop current market information and gather current statistics. The service would be such as to give the industry the benefit of current developments before the news is cold. In this work the trade associations will be relied upon for important data.

The policy of the Department of Commerce of selecting men from the industries to head the commodity divisions probably will be followed. It is recognized, however, that many of the men already in the Bureau of Mines service would be acceptable to industry for such assignments.

Recognizing that the problem of the mineral industries as a group is to find outlets for its product, it will be necessary for the commodity division to go beyond the statistics of production such as were issued by the economic division of the Geological Survey, which was transferred to the Bureau of Mines. The quest for a market for surplus output is the outstanding problem of coal, copper, zinc, petroleum, and many other mineral products. It is recognized there is need for a study of distribution and consumption and an analysis of existing markets and marketing methods as well as the promotion of new uses and the expansion of markets.

There is some thought that it would be wise to assist the commodity divisions in these studies of distribution and marketing by setting up a special unit in the service division to furnish expert assistance on problems with which the commodity chiefs may not be familiar. There is a science of marketing which has its principal application to the selling problems which are common to all business. There is no disposition to limit the force to engineers or representatives of the trade. It is hoped that expert help may be secured in the form of specialists in marketing research, in accounting and in business organization, going if necessary to the university or the large advertising houses that have made a scientific study of these fields. The experts of this special marketing unit then would be available for assignment to the commodity division, working in co-operation with the commodity chiefs on marketing surveys and on the particular problems that may require such assistance.

This particular activity is new for the Bureau of Mines, but the Bureau now is a part of the Department of Commerce and probably will assume responsibility for trade-promotion activities in so far as mining is concerned. The feeling within the Bureau is that only by so doing can it become of fullest service to the mineral industry. This new work will require additional appropriations above those already allotted for the technical work for the collection of production statistics. Thus a comprehensive program depends, in part, upon the attitude of the Director of the Budget and of the Congress.

Copper Industry Investigation Delayed

Senator Ralph H. Cameron, of Arizona, did not succeed in getting out of the committee on contingent expenses of the Senate before Congress adjourned a resolution he had introduced June 24 seeking appointment of a special committee to investigate the copper industry, but he did succeed in conducting a filibuster which tied up the work of the Senate for the last half hour of the session.

The committee did not act on the copper resolution, which remains with it until Congress reconvenes. Senator Cameron's filibuster was not connected with that proposal, but with his bill to remove the cloud on titles to land in the Verde River irrigation and power district. He first took the floor and delivered a prepared address defending himself against criticisms connected with his activities, mining and otherwise, in the Colorado River basin.

Editor's Note:

The above Washington letter reflects certain views of official Washington. Due to the fact that policy as a rule prevents government officials from permitting their views being quoted directly, the authority for these reports is necessarily somewhat vaguely referred to. The views reflected from time to time are not those of any one group of officials, but of different men, in the legislative and executive departments. There is no necessary connection between their views and "Engineering and Mining Journal" editorial policy; neither do they necessarily represent Mr. Wooton's personal views. It is felt that the opinions thus faithfully reflected will be of great interest to the industry.

Where opinions are cited from sources outside of the government, the source will be specifically stated.

Gilbert-Clifford Mine Constructing 100-Ton Concentrator

Gilbert-Clifford Gold Mines Co., operating the old Clifford silver property, 43 miles east from Tonopah, Nev., the nearest railroad and post office station, has been financed for mill construction. The plant is to be of 100 tons' daily capacity, and excavation for foundation has already been started. The company has purchased a portion of the machinery in the Spanish Belt mill, a 50-ton flotation concentration plant about 75 miles distant, and trucks have already started transportation of the machinery to Clifford. Albert Silver, formerly superintendent of milling for the Tonopah Belmont Development Co., is in charge of construction and metallurgical work. Electric power will be used, and the power line is to be extended from Tybo, 30 miles north of Clifford, to the mill site.

The Gilbert-Clifford company is shipping some high-grade ore to the West End mill at Tonopah, but its principal reserve is in low-grade milling ore which will not stand the costly truck haul to Tonopah. The company plans to have the mill in operation before the end of 1926.

Castle-Trethewey Producing 3,000-Oz. Silver per Day

The Castle-Trethewey, Gowganda, Ontario, is producing silver at an average rate of 3,000 oz. per day. Gross income is at the rate of $2,000 daily. The output is principally from ore taken out in the course of development, while the ore reserves are substantially increasing. About 1,000 ft. of lateral work is being done monthly at a cost of between $11 and $12 a foot. Milling operations are also being held down to low levels, and silver is being produced at a lower rate per ounce than at any other silver mine in northern Ontario.

Toronto Letter

By Our Special Correspondent for Northern Ontario

A Drifting Record at Gowganda —Crown Reserve, Larder Lake, Property Closed

Some mining companies are always setting up marks for others to shoot at, and this has been particularly the case with the Tonopah Canadian Mines, of Gowganda, of which E. Craig is the manager. This company has been consistently establishing new drifting records, but during the month of May the former best footage was considerably exceeded. One machine working two shifts and in two headings advanced a total of 512 ft. The drift is about 5½ by 7½ ft. and the average advance was 8½ ft. per round. The rock is quite hard, and it required fifteen holes to break the drift. A four-hole diamond cut is used with an easer just over the top. Powder costs were $2.39 per foot advance. During the last six months the average advance has been 460 to 470 ft. a month.

The Crown Reserve property, in Larder Lake, has been closed down, on account of lack of money. The company has a capitalization of 4,000,000 shares of $1 par, of which approximately 3,000,000 have been issued. It is understood that negotiations are under way for the disposal of a portion of the treasury stock, but so far nothing definite has been accomplished. In the meantime the property is being kept clear of water.

Though satisfactory results have recently been obtained at the Kirkland Lake Gold property, in Kirkland Lake, it is understood that the ore in the east drift on the 2,225-ft. level does not compare with that in the 2,100-ft. level. There seems to be a possibility that drifting has been done on the wrong vein, and crosscuts both north and south have been started in an effort to determine whether or not this is the case. So far the ore opened up on the 2,100 level will average $30. A 200-ft. oreshoot east of the shaft has been developed, one face within the last few days giving an assay of over $250 across the full width of the drift. Preparations are being made to start the mill in August.

During May production at the Tough-Oakes Burnside mine, Kirkland Lake, was $30,000. The tonnage has now been raised to 140 tons a day and before the end of the year the mill will be put in condition to handle 150 tons a day.

Sensational discoveries of free gold are reported in a 4-ft. vein on the Bennett Mining Co.'s property at Sesikinika Lake. The discovery was made within 300 yards of the railway tracks and about 1½ miles from the shaft now being sunk on the main Bennett property. The main shaft on the Bennett is now down 300 ft. and will be continued to a depth of 500 ft. before lateral work is undertaken.

Both the Nipissing and Coniagas companies, of Cobalt, have property in the Township of Montbray, in the Rouyn district, Quebec. Nipissing has a considerable surface showing, and some diamond drilling has been done. It is understood that within the last few days another discovery, which appears to be of considerable importance, has been made. On the Coniagas property, a copper discovery has also been made, which engineers returning from the district report to be very promising.

Western Quicksilver Mines Increasing Production

Domestic production of quicksilver for the first five months of 1926 approximated 3,700 flasks, or at the rate of 9,000 flasks per annum, the principal production coming from Western quicksilver properties. Imports for the first two quarters, less one week, were 12,027 flasks, indicating an apparent domestic consumption of 16,500 flasks for the half year, or at the rate of 33,000 flasks for the year. It is expected that Western quicksilver mines will increase their production over that obtaining during the last six months.

In Arizona, the Arizona Quicksilver Corporation is developing the Slate Creek and Sunflower mines, in Gila and Maricopa counties. A 4 by 50-ft. Gould rotary furnace, compressor plant, camp, and other equipment are being installed at the mine, some 76 miles north of Globe. Prospecting and development work is under way in this section.

In Nevada, the Tonopah Mining Co. is developing a promising new quicksilver property on the west side of Fish Lake Valley. A road is under construction connecting with Coaldale. A small production of quicksilver is being made in the Mina district, and lively interest is being shown in quicksilver in other parts of the state. The Goldbanks mine, south of Winnemucca, is reported to be in operation.

At Morton, Lewis County, Wash., the Fisher Mercury Mining Co. is completing the installation of a 3 by 40-ft. Gould rotary furnace, and it is expected that production will be made in the near future. The Barnum-McDonell property, adjoining, is producing from its Johnson-McKay retort furnace, but installation of a rotary furnace is under consideration.

Near McDermott, in Oregon, close to the Nevada line, the F. W. Bradley interests are installing a 4-ft. rotary furnace after having developed a promising tonnage of quicksilver ore.

In California, H. W. Gould, Charles Gray, and their associates have taken over the Aetna mine and are installing a 4 by 60-ft. Gould rotary furnace. New Idria is steadily operating and many old mines are being reopened. New Almaden is at present shut down. It is expected that California quicksilver production will show an increase over that of 1925.

Comstock Merger Producing $178,904 per Month

May production by the Comstock Merger Mines, Inc., operating near Virginia City, Nev., on the Comstock Lode, was 37,500 tons of ore, which averaged $5.02 per ton. Bullion shipped contained 4,348 oz. of gold and 135,786 oz. of silver, with total value of approximately $178,904. This represents about normal production for this company.

London Letter

By W. A. Doman

Special Correspondent

Suction Dredges a Failure in Malayan Tin Fields—Much Prospecting Under Way

London, June 22—Apparently the old type of bucket dredge used for alluvial tin mining is not to be supplanted by dredges of the newer suction cutter type. Not only have the latter proved a failure in the Malayan fields—where both the Kamunting Tin Dredging Co., which converted its fourth dredge into a suction cutter, and the Kepong company, which installed one of the new type last year, have found them unsatisfactory—but Bisichi Tin (Nigeria) has also had the same experience. In the case of the Malayan undertakings, the dredges are to be reconverted into the bucket type, but Mr. Nicholls, of the firm of Lake & Currie, has recommended to the Bisichi people that they introduce blades of somewhat different construction and put a new bearing on the cutter shaft, by which means it is hoped to restore the efficiency of the plant. In his annual report, the Senior Warden of Mines of the F.M.S. says "suction cutter dredges have definitely proved a failure."

The position and prospects of the tin-mining industry are attracting considerable attention both in this country and across the Atlantic, and although every effort is being made to increase the output so as to meet the growing demand, the Malay States, which provide about 32 per cent of the world's output of tin, was able to raise its exports last year by only about 4 per cent. Great prospecting activity is in progress in all mining areas, and many dredging companies have been floated. New plants are coming into operation, and in view of the statistical position of the metal, and despite the usual seasonal setback in the price, there is every indication that the current year's operations will be as satisfactory as those of 1925.

Sir Ernest Oppenheimer, chairman of the Anglo-American Corporation and a director of many of its subsidiaries, has just arrived in London from South Africa. He is interested in the South-West African diamond industry, and it was largely due to his efforts that the London Diamond Syndicate was reformed under conditions more favorable to some of the newer diamond producing fields.

Edmund Davis has returned from Rhodesia, where he has been visiting some of the huge concessions granted by the British South Africa Co. He appeared to be very well satisfied with the result of his 20,000-mile trip round Northern and Southern Rhodesia, and speaks well of the mineral possibilities of these vast areas. The Anglo-American Corporation has undertaken the technical management of the various Northern concessions secured by Edmund Davis and his group.

That the Burma Corporation has benefited from the high prices ruling for lead, zinc, and silver during the last year is evident from the fact that the company is able to declare a divi-

dend of 7 annas (free of Indian and British tax) on the 10 rupee shares, as against 6 annas at this time last year.

The Golden Horseshoe (Western Australia), which after a brilliant early history has been struggling on for the last few years with government assistance, is to close down. Kingsley Thomas, the government commissioner, in his report of last year, advocated the amalgamation of all the companies on the Golden Mile (Kalgoorlie). Possibly had his recommendation been adopted this concern might have been saved.

Gold Circle Acquires 48 Claims and Plans Mill

The Gold Circle Consolidated Mines Co., Midas, Nev., a recent incorporation to take over 48 claims in the Gold Circle district, in the southwest portion of Elko County, Nev., is to construct a 75-ton cyanide mill before the end of the current year. The Gold Circle district is about 65 miles from each Battle Mountain and Golconda.

Gold Circle district is an old and productive one, and among the properties taken in by the recent consolidation are the Elko Prince and the Rex mines, on both of which considerable development work has been done, and in which a substantial production has been made. The Elko Prince operated a 75-ton mill for five years, and ore reserves were not exhausted at the time the mill was destroyed by fire several years ago.

Pioneer District Active

The Reorganized Pioneer Mines Co., Pioneer, Nev., has resumed production, and the mill is operating twenty-four hours per day on good milling ore. There is a rumor that the "Mayflower," an adjoining property and former producer, is about to start production.

A movie director needed a few scenes in an abandoned city of the desert for a Western thriller. Pioneer was his first choice. He loaded a few actors and a cameraman in an open touring car and embarked on an eighteen-hour journey over the hot dusty roads of Death Valley. He was at a loss to account for the noise of stamps. Something was wrong! He investigated a few of the supposedly deserted houses in this old camp. At every door he was met by the scream of a frightened woman or the growl of a miner. Later he received the information that not a house in town was vacant nor a room available and that he would have to drive fifteen miles to find a place to rest his weary head.

Johannesburg Letter

By John Watson

Special Correspondent

Onverwacht Platinum Profits £14,500 in Three and One-Half Months—Metal Refined in London

Johannesburg, June 1—The Union Department of Mines recently issued the following comparative figures:

Value of Mineral Output for Four Months Jan. 1 to April 30

	1926	1925
Gold	£13,553,591	£13,552,403
Silver	43,477	57,259
Osmiridium	34,684	45,164
Diamonds	2,931,408	2,639,508
Coal	1,227,096	1,281,821
Copper	180,634	176,329
Tin	101,476	86,885
Other minerals	98,193	87,597
Totals	£18,171,559	£17,926,966

In April last, "other minerals" included asbestos, value £24,392; corundum, value £5,194; mica, £238, and chrome ore, value £695. The April labor figures show 34,740 whites and 297,797 natives working on the mines. The total number of mining claims held at end of April was 155,739, an increase or 4,667 compared with the end of 1925. Of this increase, more than 3,000 were base metal claims.

A new company, Onverwacht Platinum, Ltd., was registered in the Transvaal, on April 12, with a capital of £450,000 in 900,000 shares of 10s. each, all of which have been issued and are fully paid. The directors are W. H. A. Lawrence, chairman; Sir Abe Bailey, E. G. Izod, Sir Julius Jeppe, A. W. Rogers, and Sir Evelyn Wallers, all of Johannesburg. At the annual meeting of the Transvaal Consolidated Land Co., held in Johannesburg on May 27, W. H. A. Lawrence, the chairman, gave the ore reserves at the Onverwacht No. 330 hortonolite-dunite deposit, down to the 250-ft. level, as 55,000 tons averaging 10.3 dwt. On the basis of the sales made to date, the working profit for the first three and one-half months is about £14,500 or £5 5s. per ton milled—a highly satisfactory figure for the first producing platinum mine in South Africa. The Onverwacht product is treated by the Mond Nickel Co., Ltd., in London. Its refining process is working smoothly and efficiently, but it is a complicated one, with the result that a considerable interval elapses between the dispatch of crude platinum from the mine and the sale of its metal content in refined form. This interval is, however, shorter in the case of the chief product, platinum, than with the allied metals, which are also recovered. Comprehensive investigations are being made, on behalf of the T. C. L. Co., into the metallurgical treatment of the Lydenburg norite ores and, although finality has not yet been reached, progress to date encourages the expectation that this problem can be satisfactorily solved.

At the Johannesburg Rotary Club luncheon, on May 25, Dr. Wm. Cullen spoke on the future of the huge store of metals and non-metals found in South Africa; but, he said, the railways must help the export of minerals. Too many branch railways had been laid, to help farming, in districts where such railways did not pay.

On the Johannesburg Stock Exchange, during the last week, gold shares have been firm. Sub-Nigels were the chief feature and advanced with large business to 37s. 6d.; Government Areas, New Modders, and Crown Mines were all firm, with slightly improved prices. T. C. Lands improved from 48s. to 51s. during the week. Onverwachts closed the week at 16s. sales.

Copper Range Production Less

June production of the Copper Range mines, near Houghton, Mich., shows a slight reduction on account of labor shrinkage. Champion ground is maintaining its richness and Trimountain is yielding a good average as compared with other years. Baltic values have fallen off somewhat; nevertheless, the average yield of copper per ton of rock from all the mines is better than 39 lb. This is in excess of the average in 1922 and previous years.

Western Lead Suit Thrown Out of Court

The suit for $350,000 damages brought by the Western Lead Mines Co., of which C. C. Julian is president, against the *Los Angeles Times* and Corporation Commissioner Daugherty of California was thrown out of court on June 28, 1926, by Judge Doran, of Los Angeles, who held that the mining company was without sufficient cause of action in its complaint. Judge Doran held that it is the duty of the Corporation Commissioner to investigate the value of stocks and securities being offered for sale in California and that such action could not be construed as a conspiracy to discredit the stock of the company.

Mayflower Mill, (left) and Pioneer mine (right) Pioneer, Nev.

Societies, Addresses, and Reports

Executives Discuss Foremen in Industry

Important Cog in Management—Experience Alone Not Sufficient

By Jerome C. White
Assistant Editor, *Coal Age*

THE Production Executives' Division of the American Management Association, at Silver Bay, Lake George, N. Y., spent the afternoons and evenings of June 30 and July 1 and the morning of July 2 in defining the best manner in which the supervisory forces in industry can be directed and in studying the responsibility, qualifications, development, and compensation of foremen. Though most of the industries represented were manufacturing, yet an indication of the interest which the mining industry is giving to the problem of management was shown by the presentation of an address by H. S. Gilbertson, who is director of personnel of the Lehigh Coal & Navigation Co.

The function that foremen played in the different industries and their development was discussed from many angles. One member from his experience thought that the foreman was a mere figurehead reduced to the routine of doing what he was told to do according to plans and specifications.

Other representatives of large corporations stated they looked upon their foremen as managers, and held them responsible for production in quantity, quality, and cost. They agreed that the staff officers existed only to aid the foreman, who is a line officer, to carry out effectively the prearranged program of the engineering, planning and executive departments.

Natural Ability Essential

They also agreed that in the final analysis a literal compliance with the company's plans of administration was not enough; the foreman must exhibit natural ability to handle his labor and to interpret the aims, ideals, and policies of the management to the workers with whom he is in direct contact.

Many of the speakers agreed that the training and developing of foremen after their selection was but a minor problem. F. T. Cox, works manager of the West Lynn works of the General Electric Co., stated that the whole training of foremen should have but one viewpoint and that was to make a better foreman for the company. Any man who truly represented the best interest of the firm would prove in the long run of benefit to all the workers under his direction. Psychological tests and rating methods were used as selective measures. H. G. Ellerd, of Armour & Co., discussed in detail the method of rating supervisors which his company uses. This method does not attempt to put numerical values on the several qualifications. J. W. Dalzell, of the Ferro-Concrete Construction Co., stated that his company used a rating system based upon the one used by the Army. Several of the speakers agreed that rating methods of psychological tests had possibilities for development, but did not believe that they could replace good judgment in the selection of men.

Conferences Beneficial

In regard to the training and development of foremen, M. J. Kane, of the Western Electric Co., said that in his methods of training foremen he tried to keep in mind that "Telling is not teaching and information is not education." The method used by Mr. Cox, of the General Electric Co., was that of conferences on the company's time, which were attended by the heads of other departments with whom the foremen were in contact. These conferences endeavored to tie in good business principles with the foreman's actual daily work as to quality, production, costs, and labor.

H. S. Gilbertson, of the Lehigh Coal & Navigation Co., in discussing the problem as it presented itself to his company, said in part:

"When the practice of assisting the foreman in his problems is first attempted two comparatively simple ends must be kept in mind. One is to get the foreman to absorb the company viewpoint, bearing in mind, however, that all through his generation he has been in almost unrestrained authority. Our company is 106 years old. You can readily see why our foremen should resent any attempt to curb this time-honored authority and these new methods of getting results. The second thing to be undertaken is to get those men who have been in mines all their lives to see that something besides experience is needed to make efficient men, and that the company has a long-vision policy that is not bounded by the confines of any single day's work. We spent a year in studying the problem and in analyzing the reactions of each individual to find what would fit him and would fit the foremen as a class.

"We felt that training consisted of a number of things, among which was an atmosphere of sincerity. It seemed that in the old days the foremen tried to keep all they could a secret from the company, and the company kept costs, profits, and all its problems a secret from the foremen.

"We decided to publish a company paper, and in this publication we discussed costs of operation, management problems, sales, and production. In fact, we think we went further than any other company in giving out information of this sort, which has heretofore been veiled in impenetrable secrecy, This paper was one of the means whereby we interpreted the company's standpoint to the employees. Another means we used were conferences of small groups of ten or twelve foremen. At these conferences we discussed our problems at length. Later we published our own textbook on the principles of the foreman's job, covering subjects purely pertinent to our local conditions.

"We have not yet been able to measure in this short time the results of these conferences, but we have been able to see an improvement of the men's attitude toward the company and toward their jobs. The conferences were started during the early part of the last strike. The men were approached to see if they would give two hours per day of each month on company time to confer on these subjects. They became so interested in the matters discussed that they were willing and even anxious to spend more time at these conferences. The results of these discussions were summarized and then again boiled down into a general summary. The results so far gained have led us to believe that we are on the right track."

Suggests Creation of a Permanent Tariff Commission

Chamber of Commerce of the United States Advocates Changes as Result of Referendum

The Chamber of Commerce of the United States, a federation of over 1,400 chambers of commerce and trade associations, is committed by referendum vote of its membership in favor of:

1. A permanent tariff commission: to gather, investigate, and tabulate technical and statistical facts of all kinds pertinent to the tariff schedules, both in this and other countries.

2. A flexible tariff: legislation permitting, in the event of changes of economic factors, adjustment of tariff rates by administrative authorities within limits prescribed by Congress for the purpose of maintaining a consistent tariff policy.

3. A tariff adjustment board: to decide what adjustment of customs duties should be made in specific cases, within limits fixed by Congress.

The position of the Chamber on tariff matters is made clear in a recent circular, which states in part:

"Business men believe that tariff revision by Congress should be done on the basis of the best information available bearing on the United States and foreign statistics and data of production, trade, prices, wages, costs, standards of living, and other elements entering into competitive conditions between foreign and domestic industries. Tariff revision should not be made hurriedly, and should not be made on the basis of impressions and guesswork, when the pertinent facts are ascertainable. Likewise, the administrative features of the tariff bear so vitally on business that they should be worked out with great care. And our commercial policy with regard to other nations is so dependent on our own tariff administrative provisions that those provisions should be framed carefully, in the light of known facts about the tariff policies and relations of other countries and colonies. This is the field in which the United States Tariff Commission originally was created to work, and in which we feel it has done much successful work. The special studies prepared in connection with the various tariff schedules at the time of

the last tariff revision, the dyestuff studies, the comprehensive studies of colonial tariff policies and of reciprocity and commercial treaty policies, the comprehensive dictionary of tariff information and the codification of the customs laws, are all examples of useful work by an investigating body, making non-partisan studies of fact. We believe the commodity studies helped Congress materially in framing the act of 1922. We believe that fact studies of that kind should be continued and our government's information kept up-to-date.

"In the matter of commodity information, while the creation of the numerous commodity divisions in the Department of Commerce, and the strengthening of the foreign services, result in making available a great deal of information about competition and new developments in industry abroad, the United States Tariff Commission should be using this information and supplementing it where necessary, to make it applicable to the consideration of the United States tariff. We believe there is an important and permanent field of work for a permanent tariff commission. We think that field should be recognized, and the tariff commission, as a research body, made permanent and continuing.

RESULT OF REFERENDUM

"In referendum No. 37, issued Dec. 7, 1921, the membership of the Chamber of Commerce of the United States went on record heavily in favor of flexible tariff rates. The membership at that time was observing the effects of sharply fluctuating rates of exchange and instability of political conditions and fiscal conditions in foreign countries, and unnatural conditions in production and transportation. It was recognized that tariff rates are established with the purpose of protection based on the difference in the conditions of production and distribution here and abroad. It was felt that new protective tariff rates enacted in 1922 should not be made rigid, but that some administrative authority should be given to adjust the rates to changing conditions. It was on that theory that the membership of the Chamber voted in favor of flexible tariff provisions. The precise recommendation of our Committee on Tariff Principles was as follows:

'That tariff legislation should be so framed by Congress as to permit subsequent adjustment of individual rates or particular schedules of rates within prescribed limitations, and authorize changes therein from time to time without general revision of the tariff; that reasonable latitude in the application of tariff rates to any commodity, or group of commodities, be provided for, in order that there may be flexibility in the adjustment of said rates to the varying fluctuations of industrial and trade conditions.'

FLEXIBLE RATES APPROVED

"We have no reason to believe that the membership of the Chamber of Commerce of the United States has changed its views as to the desirability of having a carefully restricted system of flexible tariff rates. Our membership voted in favor of such a system in the light of the disturbing features of a general tariff revision; we believe that a system of flexible rates, reasonably administered, will prove a helpful feature of tariff legislation.

"It was recognized by our Committee on Tariff Principles that in recommending a substantial change in the technical framing of tariff legislation, to authorize flexible rates, it would not be a feasible thing to have a congressional committee sitting continuously on individual items and schedules of the customs tariff and bringing into Congress at short intervals recommendations for changes in rates. It was felt that the matter of considering changes, within fixed limitations, of the rates established by Congress should be turned over to a non-partisan board, which our committee styled as a Tariff Adjustment Board, which should act substantially as a court, conducting hearings and taking evidence, and getting reports on matters of fact from the United States Tariff Commission, and should make definite findings, which should have the effect of law. Our membership voted for such a separate tariff adjustment board.

FUNCTIONS SHOULD NOT OVERLAP

"We are not in favor of multiplying the number of government boards, but we are in favor of separating bodies with quasi-judicial functions from purely research organizations and from official bodies making official recommendations as to policy; the United States Tariff Commission in submitting its report on 'Reciprocity and Commercial Treaties' not only reported on the facts but recommended what the commercial policy of the United States Government should be, and how it should be carried out. We believe in a separation of functions, especially in connection with quasi-judicial functions bearing directly on commerce."

Carnegie to Continue Metallurgical Research

The recent reorganization of the personnel of the department of mining and metallurgical engineering at Carnegie Institute of Technology, it is announced, will in no way affect the present status of the newly organized Bureau of Metallurgical Research. The Bureau, under the direction of Dr. Francis W. Walters. Jr., and Dr. V. N. Krivebok, will continue to conduct research studies in physics as applied to metallurgy and metallography, while the department of mining and metallurgical engineering will be concerned, as in the past, with instructional work for students and research in mining and metallurgy in co-operation with the U. S. Bureau of Mines.

Louisiana May Get Geological Survey

The Shreveport Geological Society and the Louisiana Engineering Society are both sponsoring and actively supporting a bill in the present legislature providing for the establishment of a state geological survey.

Ontario Mining Association, at Cobalt, Names Brigham President

The annual meeting of the Ontario Mining Association was held at Cobalt on June 25 and 26 with an unusually large and representative attendance. The principal questions under discussion were workmen's compensation and prevention of accidents. Some important suggestions were made for changes in the law, which were referred to a committee headed by W. E. Segsworth. The following officers were elected: President, A. F. Brigham, general manager of the Hollinger Consolidated Gold Mines, Ltd.; first vice-president, Harry Oakes, president of the Lake Shore Mines; second vice-president, H. P. De Pencier, general manager of Dome Mines, Ltd.; executive committee, J. P. Watson, J. P. Bickell, F. L. Culver, J. Y. Murdock, and J. Mackintosh Bell. During the convention the members of the association were the guests of the Timiskaming Mine Managers' Association, and visited the Cobalt and South Lorrain silver camps and other points of interest. On the evening of June 25 a banquet was held at Haileybury. J. G. Dickinson, president of the Timiskaming Mine Managers' Association, was chairman. The principal speakers were A. F. Brigham and J. P. Watson. On the following day the delegates enjoyed a cruise on the lake and visits to some of the more important mining properties. Lunch was served at Ville Marie.

Kotzé Gets Medal

At the meeting of the Chemical, Metallurgical and Mining Society of South Africa, held in Johannesburg on April 17, W. Cullen announced the award of the Gold Medal of the Institution of Mining and Metallurgy to Robert Kotzé, who had been Government Mining Engineer to the Transvaal since 1908 and to the Union of South Africa since its formation in 1910. As Mr. Cullen said, the whole world of mining has heard of the Kotzé konimeter and, through the invention of this instrument, Mr. Kotzé has rendered a very great service to the cause of humanity. Then, again, the safety of the worker, both white and black, has received his constant attention, and, during the period of his administration the accident rate has been reduced by 50 per cent, which means that thousands of human lives have been saved. James Whitehouse, consulting engineer to the Central Mining-Rand mines group, read a cable from London conveying the greetings of the Institution.

Joint Meeting at Spokane

A joint meeting of the Columbia, North Pacific, Oregon, and Montana sections of the American Institute of Mining and Metallurgical Engineers will be held in Spokane, probab'y Oct. 1 and 2, and on the third day will take an excursion to inspect the mines and mill of the Consolidated Mining & Smelting Co. of Canada at Kimberley, B. C. At these meetings in Spokane and Kimberley the western division of the Canadian Institute of Mining and Metallurgical Engineers will also join.

People You Should Know About

Charles A. Mitke visited the Birmingham district of Alabama recently.

Carl Blaurock, mining engineer of Denver, whose hobby is mountain climbing, is spending a two months' vacation in the Swiss Alps.

Arthur Keith, of the Geologic Branch of the U. S. Geological Survey, left Washington on June 27 to begin field work in New England.

C. F. Jackson, mining engineer, who returned from Cyprus several months ago, has become associated with the Ranney Oil Mining Co.

H. A. Walker, superintendent of El Potosi Mining Co. at Chihuahua, Mexico, is spending his vacation on the Pacific Coast and in Salt Lake City.

H. C. Wilmot, of Los Angeles, has been in Montana and British Columbia for several weeks on examinations. He will be in Utah for the next two weeks.

John C. Howard, president of the Utah Oil Refining Co., is making a business tour of Eastern cities, including Chicago, Washington, D. C., and New York.

Melvin Brugger, mining engineer, has gone to Italy with the Charles Wright organization in connection with the development of zinc and lead properties in the Italian Tyrol.

A. Bruce Marquand, until recently general manager of the Sunnyside Mining & Milling Co., Eureka, Colo., is now in Salt Lake City, as assistant to **D. D. Muir, Jr.** **J. J. Shaw** has assumed charge at Eureka.

Ralph W. Kerns has just returned to New York, after three months' absence in Cuba, where he has been supervising the erection of a plant for the Minas de Matahambre of the American Metals Co. of New York.

H. D. Miser, of the Geologic Branch of the U. S. Geological Survey, has left Nashville, Tenn., and will soon make examinations of certain lands in the Ozark and Arkansas national forests for the Forest Service.

Walter H. Eardley, assistant manager of the Utah department of the United States Smelting, Refining & Mining Co., has returned to Salt Lake from a trip to California coast cities and Nevada mining camps.

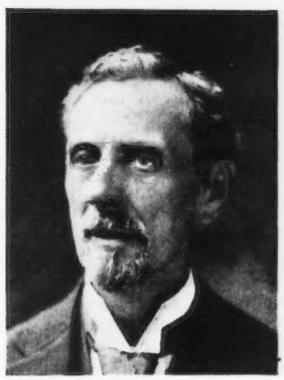
Henry Hanson, mining and metallurgical engineer of Toronto, returned to that city recently after a three weeks' trip into the Red Lake district to make examinations and reports on mining properties in that region.

George R. Hanks, formerly superintendent and later assistant to the president of Taylor-Wharton Iron & Steel Co., High Bridge, N. J., has been elected vice-president to succeed the late Victor Angerer, who died on May 5, 1926.

Charles Butts, of the Geologic Branch of the U. S. Geological Survey, left Washington on July 1 for southwestern Virginia to begin work in co-operation with the State Survey. He expects to spend four or five months in the region.

N. L. Stewart, chief mechanical engineer for the western department of the American Smelting & Refining Co., and **R. N. Robertson**, mechanical engineer, whose headquarters are in Salt Lake City, are in the East to inspect various plants in the vicinity of New York City.

Sir Evelyn Wallers will leave Johannesburg and South Africa permanently in a few weeks, having been called to London for business reasons. Lady Wallers and their daughter sailed from Capetown by the "Edinburgh Castle" on June 18 and Sir Evelyn followed a week or two later.



R. J. Walter

R. J. Walter, consulting, mining and metallurgical engineer of Denver, Colo., has been in New York on business for the last two weeks. Returning he expects to stop at Philadelphia and visit the Sesquicentennial Exposition and at Pittsburgh.

Ralph L. Healy, who has been in charge of operations at the Kay mine, Canon, Ariz., has resigned his position with the company. **T. S. Davey**, who has been mine superintendent for the last year and a half, has been appointed general manager at the property to fill the vacancy caused by Mr. Healy's resignation.

H. G. Hymer, formerly chief geologist for the Verde Central Mines Co., of Jerome, Ariz., is leaving for South Africa, where he has been offered a position as assistant to **Louis Reber**, formerly of the United Verde Copper Co. but now chief geologist for the North Rhodesian Concessions, Ltd., an English syndicate.

R. M. Murray, general manager of the Mount Lyell Co., Tasmania, Australia, is about to visit the United States, where he will investigate the latest methods for the treatment of copper ore, paying special attention to any advances that have been made in the economic handling of the metallurgical problems involved.

O. C. Martin, consulting metallurgist with the Union Minière du Haut-Katanga and Société Générale Metallurgique de Hoboken, of Belgium, is in the United States after eighteen months abroad. Mr. Martin is directing the construction and operation of a large copper refinery at Oölen, Belgium. He will return to Europe in August.

Colonel Bottomley, the Chief Inspector of Mines for the East Rand, announced at the Geduld mine on May 7 that he is retiring and that would probably be his last public appearance at a mine function. He was born in Natal and was educated in that province and at Cape Town. In 1911 he was Deputy Inspector of Mines in the Western Transvaal district.

F. S. Finnis, who has been secretary to the Wolhuter Gold Mines, Ltd., for the last three and one-half years, has been transferred to be secretary to the Transvaal G. M. Estates, at Pilgrims Rest. Mr. Finnis came to South Africa in 1899 and served three years in the Natal Mounted Police, at the time of the South African war, since when he has been employed on the Nonose Mines, City Deep, Modder B, Village Deep, and more recently in "The Corner House."

Herbert Basedow is the organizer and leader of a scientific expedition which left Adelaide, South Australia, at the end of May for the vast spaces of the Northern Territory, Australia, a region credited with containing the promise of great mineral wealth. The expedition will make geographical and scientific investigations of an area extending northwards from the southwestern corner of the Northern Territory toward the bed of the Victoria River.

F. W. Solomon, who has been mill superintendent for the Miami Copper Co. for several years, has resigned his position and has gone to Los Angeles, where he will make his residence in the future. Mr. Solomon has a record of thirty-six years in concentrating work, and has risen from the bottom of the ladder, where he started after only two years of common-school education.

Obituary

William H. Brown, 3d, geologist, was killed in a grade-crossing accident at Waxahachie, Tex. on June 28. He had been doing geological work in Ellis County, Tex. Mr. Brown was thirty-two years old.

H. H. Woods, mining engineer of Toronto, Ont., was drowned on June 23, in the Sand Island River in the Rainy River district of Ontario, when a canoe in which he was crossing the river capsized. Mr. Woods had been looking over a number of properties in which he was interested. He is survived by a wife and two sons.

Charles Morse, manager of the Government Gold Mining Areas, Ltd., properties in South Africa for the last six years, died recently at the comparatively early age of forty-four. He was born at Somerset East (Cape Province) and trained at the Royal School of Mines, London. He managed several mines in the Barnato group before being appointed to assume the direction of that interest's largest and most profitable mine.

Recent Technical Publications

Reviews, Abstracts, and References

Idaho Mining—The latest edition of Stewart Campbell's excellent handbook of the Idaho mining industry, covering the year 1925, has recently been issued. Data are given on practically every mine and prospect in the state, in greater or less detail, according to the importance of the property. Milling methods at some of the larger operations are given in special articles, illustrated with flow sheets. It is with some hesitation that improvements are suggested in what is already the best mining report issued by any state, but it would be well if a good geological or topographical map of Idaho could be included, even though it might be necessary to make a charge for the report under those conditions. Possibly the report could be supplied free without the map, as at present, or at a nominal charge with the map included. It is also suggested that the title of the book be printed on the back strip of the cover so that it may be quickly found on a shelf. Copies may be had by applying to the State Inspector of Mines, Boise, Idaho.

Mineral Resources—Separate chapters of "Mineral Resources of the United States" recently published include the following: "Coke and Byproducts in 1923," pp. 70, by F. G. Tryon and H. L. Bennit; "Gold, Silver, Copper, Lead, and Zinc in Idaho and Washington in 1924," pp. 40, by C. N. Gerry; "Lime in 1924," pp. 37, by G. F. Loughlin and A. T. Coons; "Fuel Briquets in 1925," pp. 5, by James E. Black; "Talc and Soapstone in 1924," pp. 8, by L. M. Prindle and B. H. Stoddard; and "Gold, Silver, Copper, Lead, and Zinc in Utah in 1924," pp. 25, by V. C. Heikes. The bulletin on fuel briquets is the first of the new 1925 crop, and it would be highly desirable if the others could appear before they are more than a year old. All of the above are obtainable for 5c. each from the Superintendent of Documents, Washington, D. C., except the one on coke, which is 10c., owing to its size—and possibly its age.

Refractories—The Carnegie Institute of Technology, Pittsburgh, has just issued Bulletin 23, "Service Conditions of Refractories for Open-hearth Steel Furnaces," by B. M. Larsen, F. W. Schroeder, E. N. Bauer, and J. W. Campbell, pp. 126. Though concerned essentially with steel practice, the bulletin contains much of interest to users of refractories in non-ferrous industries. A good discussion of methods of taking temperatures in an open-hearth or reverberatory furnace is included. The report is obtainable for $1.50.

Leaching Copper Ore—Allfred T. Fry has a five-page article in *Chemical Engineering and Mining Review* for May 5 (Melbourne, Australia; price 9d.) on "Leaching Copper Calcine." The author describes the general principles involved and suggests a procedure for test work, also giving some results of experiments.

Florida Phosphate—Conditions in the Florida phosphate field are discussed briefly by Edmund Shaw in *Rock Products* for June 12 (Chicago; price, 25c.). Production in that state during 1925 is estimated at 2,730,000 tons, about 85 per cent of the total United States output. Prosperity is gradually returning.

Limestone Mining—Also in the June 12 issue of *Rock Products* (Chicago; price 25c.) is an article of four pages by J. R. Thoenen on "Shrinkage Stope Method of Production From Limestone Mines." The operations of the El Dorado Lime and Minerals Co., of Shingle Springs, Calif., are described.

Rhodesia—The report of the Director, Geological Survey of Southern Rhodesia, for 1925, pp. 5, has recently been issued and is obtainable by addressing the Survey, P. O. Box 366, Salisbury, Rhodesia, Africa.

Explosives—William Cullen and J. H. Ronaldson have a paper in the *Bulletin* of the Institution of Mining and Metallurgy for May, entitled "Data on the Use of Explosives in Mining." A general description of British practice is given, with several pages of data on holes drilled and explosives used in many mines in various parts of the world. Copies are obtainable for 1s. each from the Offices of the Institution, Cleveland House, 225, City Road, London, E. C. 1, England.

Magnetic Separator—In the bulletin mentioned in the previous paragraph, H. S. Hatfield has a brief description of "A New Magnetic Separator for Feebly Magnetic Minerals." One of the machines is being used in England for separating glauconite from quartz sand. The paper is obtainable for the same price as the one mentioned above.

Palladium—The May *Bulletin* also contains a three-page paper on "Palladium: A Method for the Rapid Estimation of Small Quantities," by Francis C. Robinson, obtainable for 1s. as above.

Mining Nickel Ore—J. A. Orr in the June *Bulletin* of the Canadian Institute of Mining and Metallurgy (Montreal; price $1) describes certain phases of present mining practice at the Creighton copper-nickel mine, in the Sudbury district of Ontario. The paper supplements one published by the Canadian Institute six years ago, and covers recovery of pillars, drawing the ore, changing from sublevel tramming to a branch-raise system, and chute construction. The present stoping practice is the same as formerly—that is, flat-backed shrinkage stopes 60 ft. wide, between rib pillars of 15-ft. width extending from the footwall to the hanging-wall.

Geology—A small book of interest to the geologist and mineralogist has recently been issued in Italy, entitled "Ricerca dei Giacimenti Minerali e delle Acque Sotterranee," by Mario Grossi. The book is obtainable for 25 lire from the publisher, Ulrico Hoepli, Milan, Italy.

Homestake—The May issue of *The Black Hills Engineer* (The South Dakota State School of Mines, Rapid City, S. D.; price 25c.), is the Homestake semi-centennial number, and is almost entirely devoted to the operations of the Homestake Mining Co. Included is a historical sketch of the mine, an outline of the mining methods, articles on geological conditions, a review of Homestake gold metallurgy, a description of the tungsten mill operated during the war, articles on the mechanical and electrical installations, and a chapter on lumbering operations in the Black Hills.

Lead Mining and Milling—The June issue of *Mining and Metallurgy* (American Institute of Mining and Metallurgical Engineers, New York; price 50c.) contains several good articles on lead mining and milling, including: "Lead, Its Demand and Future," by W. J. O'Connor; "World Lead Deposits," by Waldemar Lindgren; "The Future of the Lead Supply," by James W. Wade; "Economic Aspects of Flotation," by Galen H. Clevenger; "Present Tendencies in Smelting and Leaching Lead Ores," by R. C. Canby; and "Handling Complex Lead-Zinc Ores at the International Smelter," by W. C. Page. All of these papers had been presented at recent sectional meetings of the Institute.

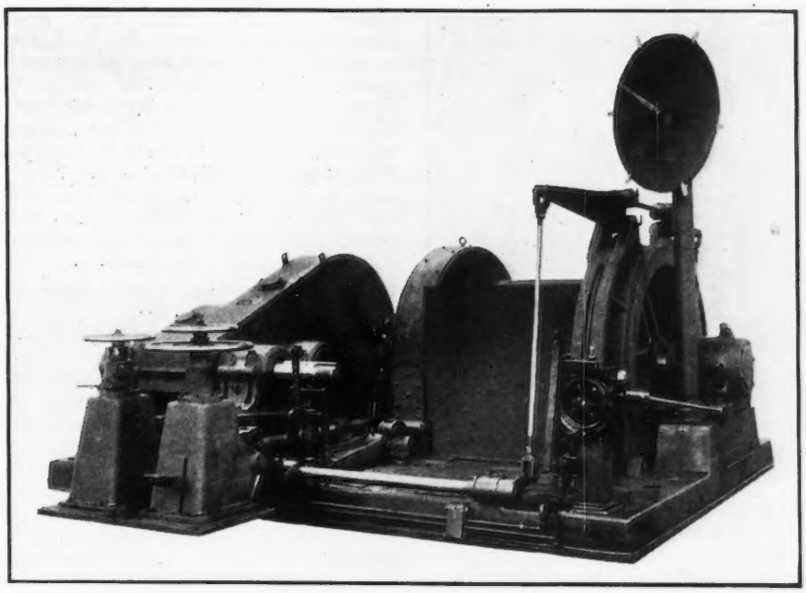
Economic Geology—*Economic Geology* for June-July (Lancaster, Pa.; price 75c.) contains the following papers: "Magmas and Igneous Ore Deposits: Part II," pp. 25, by J. H. L. Vogt; "Thickness of Incompetent Beds in Oil Fields," pp. 20, by W. W. Rubey; "Genesis of Magnetite Deposits, Vancouver," pp. 13, by W. L. Uglow; "Identification of Coals," pp. 12, by T. B. Williams; and "Magnetite - Martite - Hematite," pp. 20, by J. W. Gruner. There are also brief discussions of "Electrical Conductivity of Ore Minerals" and "Angular Inclusions in Ore Deposits."

Accident Prevention—The June issue of *The Mining Congress Journal* (Washington, D. C.; price 30c.) contains several papers on accident-prevention work, including articles descriptive of what is being done in the Tri-State district, and at the Homestake mine.

Electrical Fume Precipitation—"Electrical Precipitation as Applied to Gas Streams," is discussed by H. R. Hanley in a 64-page bulletin recently issued by the School of Mines and Metallurgy, Rollo, Mo., and obtainable on request. This is an informative and simply written report on the Cottrell method of fume precipitation, giving the principles on which it is based, how they are applied, and the results secured in commercial plants.

Electric Locomotives—The British Mines Department has issued a bulletin entitled "Electric Storage Battery Locomotive Competition," being a report on a recent contest to adjudicate upon such locomotives for use in British coal mines. The various designs are discussed in the light of the test work. Copies of the bulletin are obtainable for 1s. 3d., presumably from the British Library of Information, 44 Whitehall St., New York City.

New Machinery and Inventions



This hoist of the British Empire Steel Corporation, at Glace Bay, Nova Scotia, lowers its load, returning power to the line, and has other interesting features

New Electric Hoist Has Unusual Features

Designed to Lower Load and Thus Return Power to the Line

By H. V. Haight

Chief Engineer, Canadian Ingersoll-Rand Co., Ltd.

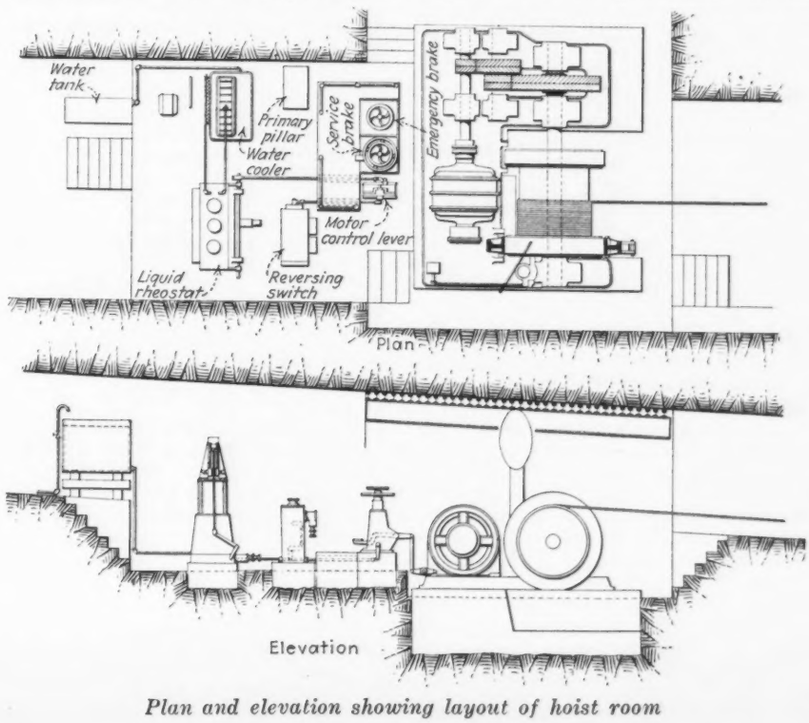
A NEW HOIST that recently was installed at one of the collieries of the British Empire Steel Corporation at Glace Bay, Nova Scotia, presents a number of details that should be of interest to those having hoisting problems outside of the coal industry. Probably the most interesting feature is that the hoist is to be used chiefly to lower coal, and in doing so will return electric power to the line. The colliery is chiefly submarine, and the hoist will be installed out under the sea, the distance from the shaft to the point of installation being 13,400 ft. The hoist is placed at the top of the rise, and its duty is to haul the loaded trip out of the subsidiary levels and up on the grade far enough to clear the switch points, then to lower the trip down to the main haulage levels. There the loaded trip is uncoupled, the empty trip coupled on, and the empties are hauled up the grade and lowered into the room landing. The length of slope is about 4,000 ft. Although there is a rather high load on the motor when hauling the loaded trip clear of the switch points, yet the average load, when acting as a motor, is comparatively low, and a 250-hp. motor would be sufficient. The generator load, however, when lowering the loaded trip down 4,000 ft., is fairly high and necessitated the selection of a 400-hp. motor.

The principal data as to the hoist and its duty are as follows:

Weight of empty car, pounds	2,400
Capacity of car, pounds	4,525
Number of cars in a trip	17
Total weight loaded trip, pounds	117,725
Maximum grade, per cent	10
Rope pull (dead load), pounds	15,500
Electrical conditions 2,200 volts, 25 cycles, 3 phase	
Motor horsepower	400
Motor speed, r.p.m.	750
Drum speed, r.p.m.	83
Rope speed, feet per minute	1,250
Diameter of rope, inch	1
Diameter of drum, inches	50
Length of drum, inches	48
Rope capacity of drum, feet	5,000

The cut below shows the way in which the hoist is being installed, and helps to explain some features of its construction. In order that the clear span of the roof might be no greater than necessary, the motor is mounted on the hoist bed, directly behind the drum. To get the hoist into place, every part had to be of such size that it would pass though a 5x6-ft. opening. That made it necessary to use double reduction gears to keep down the diameter of the drum gear. On account of its use in a coal mine, all the electrical equipment is flame-proof. To provide for quick repairs all bearings have renewable sleeves and all parts are held together by bolts, no studs being used.

The hoist was built by Canadian Ingersoll-Rand Co., Ltd., at Sherbrooke, Quebec. The drum has a cast-steel barrel bolted to cast-iron spiders. Each spider has a brake path, one for the service brake and one for the emergency brake. The service brake is of the post type. The posts are of cast iron reinforced by a steel rod on the tension side. Both front and rear posts are carried on links which form a parallel motion. Equalizing rods give equal pressures all round when the brakes are set, and adjustable stops provide equal clearance when the brakes are released. The brakes are set by combined foot level and hand wheel. When the foot lever is depressed, it makes immediate application of the brakes, and the hand wheel may then be turned to reinforce the pressure of the foot treadle and to lock the brakes. The emergency brake is of the band type. It is set by weights, hanging below the bed, and is released by a hand wheel. The rate at which the brake is set is controlled by an oil gag pot. The oil passing from the bottom to the top of the gag pot passes through a valve on the Lilly controller, which thus controls the speed of application of the emergency brake. The emergency brake is tripped by a magnet in a safety circuit. If this



Plan and elevation showing layout of hoist room

circuit is opened, the armature of the magnet falls, knocking out a latch, which in turn allows a half-nut to open and the brake to set. The safety circuit will be opened by the Lilly controller in case of overwinding, overspeeding, or approaching the end of travel at too great speed. A hand-operated emergency switch is also provided for the use of the operator. The safety circuit is also connected to the primary pillar so that the motor is shut off at the same time the emergency brake is set. Service and emergency brakes are lined with Ferodo lining.

The drum is driven through a friction clutch of the Lane band type. As the load on the driving disk of the clutch is very heavy, it is made of cast steel, in halves, clamped to the shaft over a key, by heavy bolts. The fixed arm of the clutch is cast integral with one half of the disk. The loose arm is of the yoke type, so that both the pivot pin and the pin which engages with the band are supported at both ends. The clutch band is also lined with Ferodo lining. The clutch is operated by a hand wheel which is concentric with the wheel of the service brake.

To provide for the drum running free of the shaft, it is bushed with renewable bronze bushings. Lubrication of these bushings is effected by Saal fittings and an oil gun.

The driving gears are all Falk double-helical cut-steel gears and are rigidly supported by bearings close to the gears on each side. The gears are inclosed in an oil-tight case with inspection openings where the gears mesh.

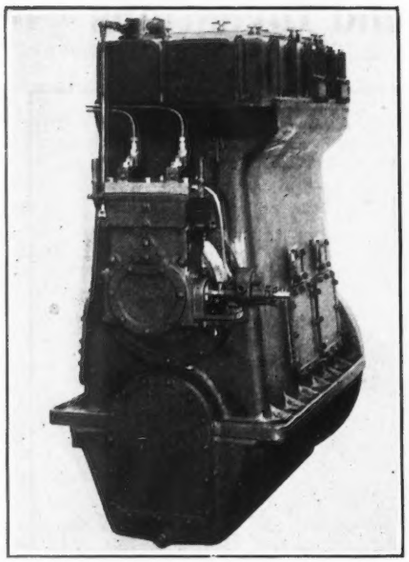
All the drum-shaft bearings are of the angle type, to suit the direction of the rope pull, and are lined with bronze sleeves. They are grease-lubricated. The bearings of the intermediate shaft and the motor pinion shaft are of the ring-oiling type and have renewable babbitt-lined sleeves.

The pinion shaft is gear driven and the hand makes one turn in 5,000 ft. To insure accuracy in the position of the hand, in spite of any lost motion in the gearing, a constant tension is provided by means of a small rope sheave and hanging weight.

The motor was built by Canadian General Electric Co., Ltd., Toronto, Ontario. It is a 400-hp. wound-rotor induction motor. The shaft has roller bearings. The collector rings are outside the bearings and are inclosed in a flame-proof case. Wire guards prevent accidental contact with the rotor. The rotor is designed to be safe at 100 per cent excess speed.

The control equipment was built by Allen West & Co., Ltd., Brighton, England. It consists of one of their LA3B liquid controllers of the moving electrode type, and oil-immersed stator reversing switch and hand operated lever gear. It is of the inclosed flame-proof type and has a capacity of 2,200 hp. minutes every quarter hour, with a continuous dissipating capacity of 150 hp., which would enable a creeping speed to be obtained continuously against 30 per cent full load torque for rope inspection purposes.

The primary switch pillar was furnished by Ferguson, Pailin, Ltd., Manchester, England, and is described as type "B3" drawout, floor-mounting, flame-proof, mining-type switch pillar.



This Diesel is built especially for industrial machine use

High-Speed Diesel for Power Shovels

A light high-speed Diesel oil engine built especially for industrial machine use is now being manufactured by the Foos Gas Engine Co., Springfield, Ohio. The series of engine capsules range from 40 to 400 hp., having from one to eight cylinders. Speeds are set to meet the driven machine's requirements, usually ranging from 600 to 900 r.p.m.

In this new engine, one of the first American high-speed Diesels placed in commercial service, no spark plug, hot tube, or other device is used to ignite the fuel. The compression is carried to 450 lb., sufficient to provide auto ignition. Combustion proceeds at constant pressure, with the result that the cylinder pressure is but little higher than experienced in a gasoline engine. The weight ranges from 40 to 60 lb. per brake-horsepower.

No attempt has been made to reduce the weight by the last possible ounce, for a fairly heavy weight is satisfactory for power-shovel and excavator use, since it is customary to add dead weight to the platform when light-weight gasoline engines are used.

The fuel consumption is less than 0.45 lb. per horsepower-hour, using a fuel oil costing less than 5c. per gallon. This figures out as approximately 17 horsepower-hours per gallon.

Shovel and Dredge Business Changes Hands

The Osgood Company has purchased from the receiver of the Fairbanks Steam Shovel Co., at Marion, Ohio, the good will and all the assets of the Fairbanks company, such as patterns, records, drawings, and formers, together with the entire stock of material that was on hand for the manufacture of steam and gas shovels and dredges. The purchasers are prepared to furnish from the records and drawings now in their possession repair parts for Fairbanks machinery and equipment that is now in the field.

Tracing Paper Is White and Odorless

The tracing paper now being manufactured by the Special Paper Manufacturing Co., 96 Reade St., New York, is said to overcome two objectionable features characteristic of many vellums. The product is absolutely odorless and of a white texture. Claims made for the paper, which is known as "Vellux," are that the odorless feature adds to the efficiency of the draftsman and that a white paper gives much better blueprints than does a yellow.

New Bearing Has Oil Circulation and Filtration Features

A bearing now being manufactured and distributed by the Willamette Iron & Steel Works, Portland, Ore., possesses the dual features of automatic circulation and filtration of the oil. Behind the bearing surface a reservoir is provided, from which the oil passes, through small feed passages, to the shaft. At each end of the bearing are provided oil-return ducts, filled with wool waste, through which the oil is filtered. These ducts connect with the oil reservoir, and a definite circulation of lubricant is established and maintained. A feature of the bearing is a provision so that the part subjected to the greatest pressure and the greatest friction gets the largest amount of oil. The results are said to be an unusual freedom from bearing trouble and a significant saving in the consumption of oil.

These bearings are being manufactured in flat bottom, internal collar, drop hanger, rigid post ball and socket, and various other types for special purposes to accommodate all shaft sizes.

Trade Catalogs

Rail Bonding—An instruction poster describing the difference between the steel metallic and copper metallic arc-welding processes, and illustrating the proper method of applying the Titon and AW-12 arc weld bonds, has just been published by Ohio Brass Co., Mansfield, Ohio. The poster is intended as a guide for welders responsible for the installation of rail bonds. Copies are available without cost on request to the company.

Compressors, Drills, Hoists — Three bulletins have been issued recently by the Sullivan Machinery Co., 122 South Michigan Ave., Chicago, Ill. They are: Bulletin No. 81-L, on rock-drill tunnel carriages; No. 76-G, on portable single- and double-drum electric hoists; and No. 83-B, second edition, on single- and two-stage straightline air compressors for belt drive.

Flotation Machinery — The Southwestern Engineering Corporation, Los Angeles, Calif., has just issued an 8-page folder on its new portable flotation mill, copies of which will be sent on request.

Pump—The Worthington locomotive feed-water heater and boiler-feed pump is covered in a 28-page catalog (BK-1607-D) issued by the Worthington Pump & Machinery Corporation, 115 Broadway, New York.

The Market Report

Copper Climbs Close to 14c.

Firm Prices, in Spite of Limited Activity, Characterize Non-Ferrous Metal Markets—Lead Steady; Zinc and Tin Up

New York, July 7, 1926—Lead buying continued brisk during the week ending today, despite the holiday season. The volume of business in zinc was moderate, and in copper only fair. However, prices for the last two metals strengthened appreciably and lead is firm at the figures that have prevailed for several weeks. Silver is dull and easy, tin dull and strong, antimony dull and steady.

Better Sentiment in Copper

A very definite improvement in the copper market is evident today. Inquiry was good on Tuesday, following the Fourth, and apparently all of the metal available at 13.875c. delivered disappeared from the market, and 13.925c. appears to be the bottom today, with most producers holding at 13.95c. and 14c. Last Thursday two good sales in the Middle West brought 13.95c. and 14c., and this is reflected in our quotation for that day, although at the same time several large lots changed hands at 13.85c. On Friday and Saturday 13.875c. was the only figure reported. The volume of business was not large, but was measurably better than that of either of the two weeks immediately preceding.

The developments of the week seem to have removed whatever obstacles remained in the way of the launching of the export association, and an official announcement that it is in operation is expected before the middle of the month. Incidentally, the organization is likely to be styled The Association of Copper Exporters, recasting the old name.

Some selling abroad is reported at 14.075c. and 14.10c. c.i.f., and in the f.a.s. market from 13.825c. to 13.875c. has been realized for September-October delivery, the higher figure being the most recent. At least two of the larger exporters are holding at 14.20c. and consequently are out of the market.

Lead Buying Continues Strong

The lead market continues to lead the major metals in the volume of buying. Corroders are again prominent buyers, and in one or two instances have been compelled to pay a higher premium than usual for July delivery. Most of the buying has been for either prompt shipment or for the July position, and the prevailing figures have been 8.10c. in St. Louis and 8.25c. in New York as the basis for common lead. In a few instances premiums have been paid, but this is not general. The American Smelting & Refining Co. continues its official contract price in New York at 8.25c.

Firmer Undertone in Zinc

Although the domestic market has not been active, the undertone is good and prices have stiffened perceptibly. Producers of concentrate in Joplin are inclined to hold out for $50 per ton, as against $48 offered by the smelters. With a sharp curtailment in production occasioned by the shutdown over the Fourth (in some cases for a full week), they are in a good strategical position, and a better price for concentrate is probably reflected in the strength of the market for slab zinc. Brass Special is said to be plentiful, and the usual premium of ten points has been shaded in some instances. High Grade continues to be quoted at 8.50c. in New York.

Daily Prices of Metals

July	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
1	13.60@13.70	59.375	61.625	8 25	8.10@8.125	7.175@7.20
2	13.625	59.375	61 75	8 25	8 10	7.175@7.25
3	13.625	59.375	61.75	8 25	8 10	7.20
5	Holiday	.....	.....	.....	.....	.....
6	13.625	60 125	62 375	8 275	8 10	7.20@7.25
7	13.675@13.70	59 75	62 00	8 25	8.10	7 225
Av.	13.643	59.600	61 900	8.255	8.103	7 210

The prices correspond to the following quotations for copper delivered: July 1st, 13.85c.@13.95c.; July 2nd and 3rd, 13.875c.; July 5th, Holiday; July 6th, 13.875c.; July 7th, 13.925c.@13.95c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

July	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
1	56 7/8	57 3/4	64 1/2	273 7/8	273 3/4	30 1/16	30 1/16	33 9/16	33 9/16
2	56 3/4	57 1/2	64 1/2	273 1/2	273 1/2	30 1/16	30 1/16	33 1/2	33 9/16
5	57 1/8	57 7/8	64 1/2	275 1/2	275 3/4	30 1/16	30 1/16	33 3/4	33 11/16
6	57 1/8	57 7/8	64 1/2	277	277 1/4	30 3/8	30 3/8	33 7/8	33 7/8
7	57 1/8	57 7/8	64 3/4	276 3/8	276 5/8	30 3/4	30 3/4	33 13/16	33 13/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

July	Sterling Exchange "Checks"	Silver		Gold London	July	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
1	4.86	65 5/8	30 1/4	84s11 1/2d	5	Holiday	...	30 1/4	84s11 1/2d
2	4.85 7/8	65 3/4	30 5/16	84s11 1/2d	6	4 85 3/4	65 5/8	30 1/8	84s10 1/2d
3	4.85 7/8	65 3/4	30 5/16	.....	7	4 85 3/4	65 1/4	30 1/16	84s11 1/2d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Straits Tin at 62c.

The week has been dull in the domestic tin market, though in the last day or two consumers have shown some interest. On Monday and Tuesday sharp advances were made in London as a result of speculative buying and some purchases on Continental account. This caused a sympathetic increase in the New York price on Tuesday, but the market seems easier today. August is about $\frac{3}{8}$c. under prompt and September $\frac{1}{2}$c. below.

Silver Steady but Dull

The silver market advanced slightly for the first three days of the month on the strength of local orders for China account, but after the holiday buying became very limited, and rates eased off again in consequence.

Mexican Dollars (Old Mexican pesos): July 1, 50$\frac{1}{4}$c.; 2d and 3d, 50$\frac{3}{8}$c.; 5th, holiday; 6th, 50$\frac{1}{4}$c.; 7th, 50c.

Francs Recover Slightly

After displaying marked weakness, both French and Belgian francs have recovered some of the lost ground. Closing cable quotations on Tuesday, July 6, are as follows: francs 2.74c.; lire, 3.455c.; and marks, 23.81c. Canadian dollars are at a premium of $\frac{1}{8}$ per cent.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

Aluminum—99 per cent grade, 28c. per lb.; 98 per cent, 27c. London, 98 per cent, £116@£118 per long ton. Market in Britain dull.

Antimony—Per pound, duty paid, New York: Chinese brands, spot, 13.50@13.75c. August arrival, 12.50@12.75c. Cookson's "C" grade, spot, 20$\frac{3}{8}$c. Market dull and prices mostly nominal with some buying by speculative interests.

Bismuth—Per pound, New York, in ton lots, $2.70@$2.75. London, 10s.

Cadmium—Per pound, New York, 60c. London, 1s. 11d. for American metal; 1s. 9d. for Australian metal.

Iridium—Per ounce, $125@$135 for 98@99 per cent. Nominal. London, £63@£65 in iridio-platinum.

Nickel—Per pound, ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade). London, £170@£175 per long ton according to quantity.

Osmium—Per ounce, $65@$75; London, £17@£20.

Palladium—Per ounce, $70@$72. As a constituent of crude platinum, $60@$65 per oz. London, £12@£15, nominal.

Platinum—Refined, per ounce, $114 officially quoted. Sales also at $110@$111. Crude, $109. Market has stiffened in the last few weeks; better buying.

London, £22$\frac{1}{2}$@£23$\frac{1}{2}$ per ounce for refined, and £20$\frac{1}{2}$@£21 for crude. Demand limited.

Quicksilver—Per 75-lb. flask, $91.50@$92. Market is firm for futures; weaker for spot. San Francisco wires, $89.83. London £15.

Ruthenium—Per ounce, $60@$70, nominal; London, £12@£15.

The prices of **Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Radium, Rhodium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium** are unchanged from the issue of July 3.

Metallic Ores

Tungsten Ore—Per unit of WO_3, N.Y.: Wolframite, $10.50@$10.60; Western scheelite, $10.75@$10.85. Some consuming demand for the first time in many weeks.

Vanadium Ore—Containing 4 to 8 per cent V_2O_5, 30@35c. per pound of V_2O_5 f.o.b. Montrose, Colo.

Foreign concentrate (lead vanadate) 12 to 18 per cent V_2O_5, 60@65c. per pound V_2O_5, duty paid, seaboard.

Chrome Ore, Iron Ore, Manganese Ore, Molybdenum, Tantalum, and Uranium are unchanged from quotations in the July 3 issue.

Zinc Blende and Lead Ore Prices Unchanged

Joplin, Mo., July 3, 1926

Zinc Blende	Ton
High	$52.45
Premium, basis 60 per cent zinc	$49.00@50.00
Prime Western, 60 per cent zinc	48.00
Fines and slimes, 60 per cent zinc	47.00@44.00
Average settling price, all blende	47.28
Calamine	
Basis 40 per cent zinc	$28.00@30.00
Galena	
High	$102.10
Basis 80 per cent zinc	100.00
Average settling price, all lead	99.88

Shipments for the week: Blende, 16,980; calamine, 141; lead, 2,585 tons. Value, all ores the week, $1,064,070.

Reports persisted early in the week that $49 basis was offered for Prime Western zinc blende, but buyers today deny having made such offers, and the price closed tonight at $48.

Shipments exceeded the production more than 3,000 tons, but purchases were 6,000 tons less than the production. Several mills were closed Wednesday, others Thursday, while a large majority closed Friday night. None of those observing the Fourth of July will resume before Tuesday, and some of them will remain down all next week. Estimates are that production will be lowered 10,000 tons in the two weeks.

Lead is quoted at $100 basis, but it is known that at least one sale was made on a basis of $101, and the increased shipment indicates that better than $100 basis was paid for several bins.

Platteville, Wis., July 3, 1926

Zinc Blende.	Per Ton
Blende, basis 60 per cent zinc	$50.75
Lead Ore	
Lead, basis 80 per cent lead	$100.00

Shipments for the week: Blende, 976 tons; lead, 80 tons. Shipments for the year: Blende, 27,192; lead, 752 tons. Shipments for the week to separating plants, 2,379 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Rutile, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the July 3 issue.

Mineral Products

Arsenious Oxide (White arsenic)—3$\frac{1}{2}$c. per lb. Occasional carlots sold. London, £14 per long ton.

Copper Sulphate, Sodium Nitrate, Sodium Sulphate (Salt Cake), and Zinc Oxide are unchanged from prices in the July 3 issue.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, $88@$90 per gross ton, furnace; prompt and future.

Ferrosilicon — Per gross ton, f.o.b. works: 50 per cent, $85 delivered in carload lots; 75 per cent, $145; 14-16 per cent, $46.

Ferrotungsten—Per pound contained W, f.o.b. works according to grade, $1@$1.05.

Ferrocerium, Ferrochrome, Ferrophosphorus, Ferrotitanium, Ferrouranium, Ferrovanadium, and Spiegeleisen are unchanged from prices in the July 3 issue.

Metal Products

Rolled Copper—Per pound, sheets, 22$\frac{1}{2}$c.; wire, base price, 16c.

Zinc Sheets—Per pound, f.o.b. works, 11.25c.

Lead Sheets, Nickel Silver, and Yellow Metal are unchanged from prices in the July 3 issue.

Refractories

Chrome Brick, Firebrick, Magnesite Brick, Silica Brick, and Zirkite are unchanged from prices in the July 3 issue.

Steel Steady—Pig Iron More Active—Coke Unchanged

Pittsburgh, July 6, 1926

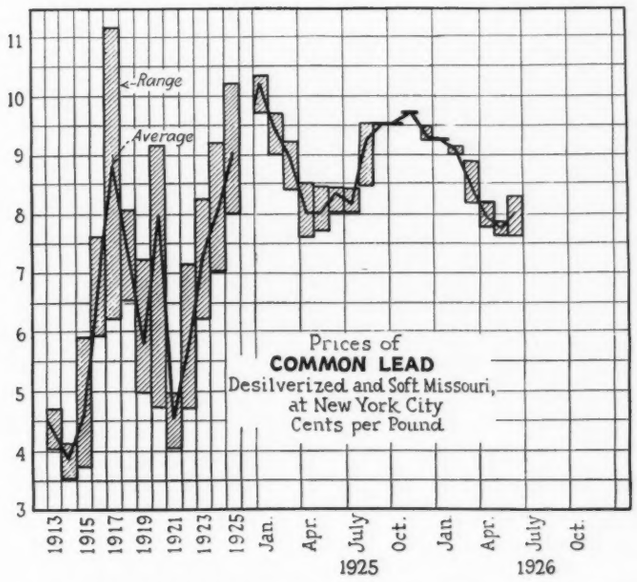
Actual buying of steel has been somewhat lighter in the last fortnight than formerly, but this is fully accounted for by the time of year. June purchases exceeded those of May, which in turn had exceeded buying in April, the low month in the half year.

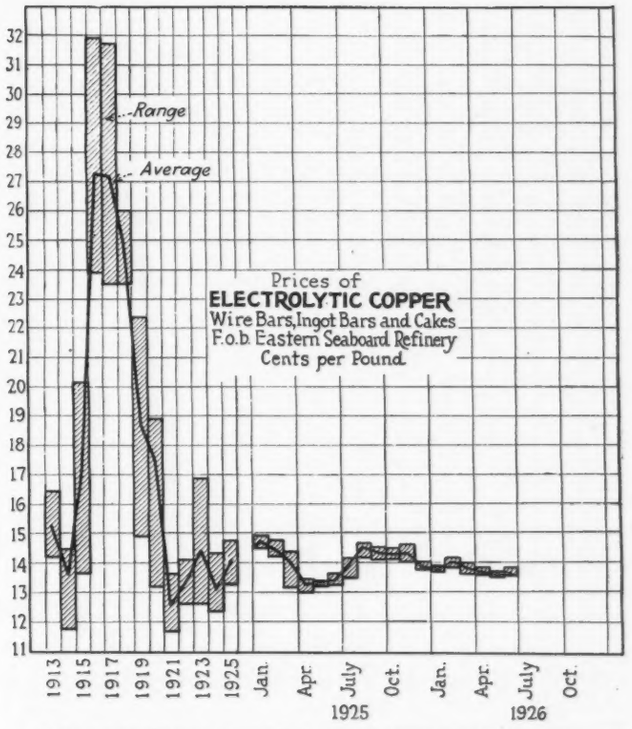
Steel prices show in general a better position. Some lines have had no variations for months. Transactions show shapes to be quotable at 2c., a $2 a ton advance, plates are admittedly 1.90c., and carloads of bars can be bought at 2c.

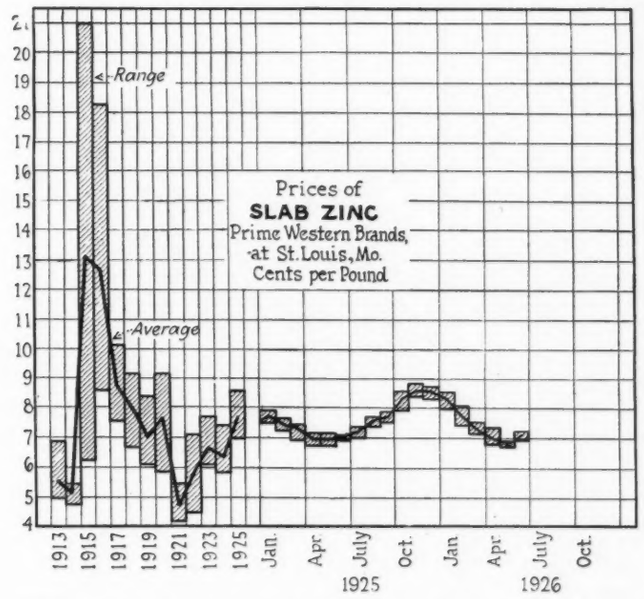
Pig Iron.—The general pig-iron buying movement of the last few weeks has rolled up a large tonnage, but this is not particularly significant, as stocks and contracts were thoroughly liquidated and prices were low. The Valley market is a little more active, Westinghouse Air Brake Co. having bought 15,000 tons for second half. Foundry iron is down 25c. and basic 50c., making the lowest prices since December, 1915. Bessemer, $19; basic, $17.50; foundry, $17.75, f.o.b. Valley furnaces.

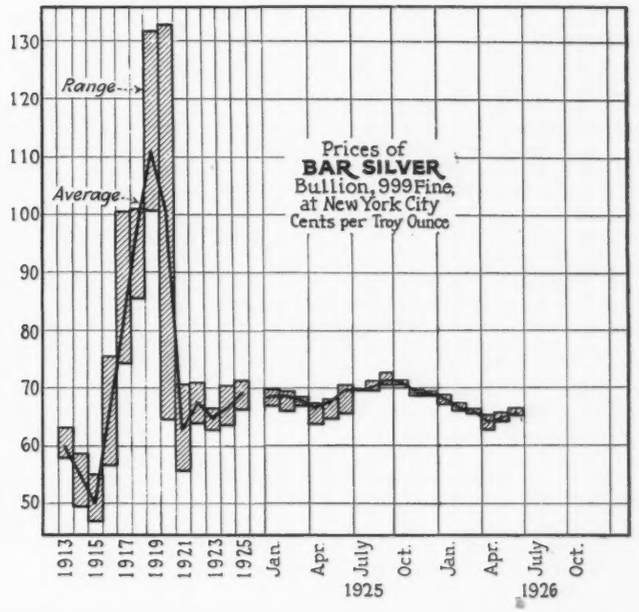
Connellsville Coke.—Spot furnace, $2.75@$2.85; spot foundry, $4@$4.50.

Metal Price Curves

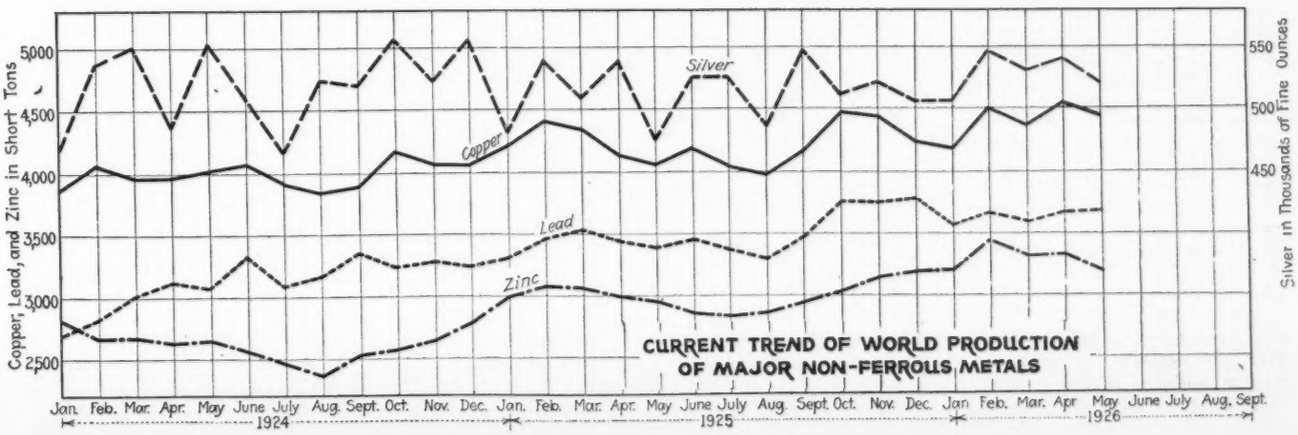



Range
Average
Prices of
ELECTROLYTIC COPPER
Wire Bars, Ingot Bars and Cakes
F.o.b. Eastern Seaboard Refinery
Cents per Pound
1913 1915 1917 1919 1921 1923 1925 Jan. Apr. July Oct. Jan. Apr. July Oct.
1925 1926





THE curves below are not to be considered as permanent records of production. They show merely the current trend in terms of daily output, according to latest estimates of the American Bureau of Metal Statistics. The figures represent countries that produced in 1924 and 1925 about 97 per cent of the world's output of copper; 78 per cent of the lead; 87.5 per cent of the zinc; and 81 per cent of the silver.


Silver
Copper
Lead
Zinc
Copper, Lead, and Zinc in Short Tons
Silver in Thousands of Fine Ounces
CURRENT TREND OF WORLD PRODUCTION
OF MAJOR NON-FERROUS METALS
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept.
1924 1925 1926

Review of Current Statistics

By Arthur B. Parsons
Assistant Editor

JUNE saw a decided improvement in the Weighted Index of Non-Ferrous Metal Prices. As appears on the graph on the opposite page, the decline had been steady since December, May being almost as low as April, 1925, when the bottom was reached last year. Producers naturally hope—and their hopes are not without substantial support—that the course of the markets, during the remainder of the year at least, will be upward, as it was in 1925. The period shown on this chart is too short to form the basis of any generalization; yet it is interesting to note the absence of a single erratic month: when a trend is established it seems to persist until the time comes for a sustained movement in the other direction.

In the expectation that this tendency will hold during the period immediately ahead of us, metal miners should view with optimism the upturn in June. More substantial ground for confidence is the growing impression that forecasts made two months or so ago exaggerated the extent of the impending contraction in the volume of manufacturing and industrial activity. At this writing, although no one anticipates any general acceleration, many are inclined to predict a continuation of consuming industry at the present reasonably satisfactory rate.

The two curves at the bottom of this page suggest that the metal miner is not so badly off as he might be. At least his position is better than it was in 1922-23-24, and the first eight months of 1925. The Bureau of Labor index for all commodities reflects the cost of producing metals: the prices of materials used and, indirectly, the wage scale are, speaking broadly, proportional to the general commodity index. On this basis the spread between the two lines of the chart expresses an advantage for the metal miner. The comparison, of course, is relative and not absolute.

So far as the individual metals are concerned, the most important increase is in lead, with zinc, copper, and silver following in the order named. Tin has declined slightly, whereas aluminum and nickel are unchanged.

A small decline in the Non-Metallic Mineral Price Index is accounted for by weakening in feldspar and magnesite. Although the volume of business is said to be from fair to good, prices for magnesite are easier.

Demand for asbestos, especially the shorter grades, has lessened, but prices are unchanged. This illustrates the virtues, from the miner's point of view, of an industry that is nearly monopolized so far as American production is concerned. The "trust" in Quebec has curtailed output of some products, but the price cutting that once characterized the industry in Canada is notably absent now.

Mining company shares fared well on Wall Street—and in the various little Wall Streets in Boston, Toronto, and Salt Lake—during May. Of the thirty-three representative stocks included in the three groups used to calculate the indices shown, only five closed the month at levels below those prevailing at the end of May. Two were unchanged and the others improved their position.

In the mining-smelting manufacturing group the A. S. & R. Co. achieved in May a climb of $9 per share, and National Lead did almost as well. Owing to the much larger number of outstanding shares the improvement in Smelters is the bigger factor in the index number. International Nickel, the only one to decline, eased but ⅛ of a point.

E.&M.J. Weighted Index of Non-Ferrous Metal Prices

100 Is Composite for 1922-3-4

1920	130.92
1921	80.80
1922	93.94
1923	103.43
1924	102.63
1925	134.38
Average Six Months, 1925	109.56
Average Six Months, 1926	108.59
April, 1925	104.75
April, 1926	105.93
May, 1925	105.34
May, 1926	105.43
June, 1925	107.19
JUNE, 1926	106.68

Among the copper shares Calumet & Hecla, which experienced a fractional decline, was the single exception to a general moderate appreciation. Chile recovered the ground lost last month and closed at $33. Because of the large number of shares (4,391,245), a small change in the Chile quotation affects the index considerably. Calumet & Arizona reached a new high for the last three years, probably as a consequence of the development of large bodies of very rich direct-smelting ore at Bisbee. It closed at 64¾, a gain of 4¾. Miami's strength, by curious contrast, is due to low-grade ore. The company has demonstrated its ability to make copper for 11c. per pound from ore yielding only 14.75 lb. of metal per ton. Nevada Consolidated, with the Ray-Chino absorption finally effected and officially approved, showed strength, as did Inspiration and Granby. The others picked up fractionally, by virtue of firmness in the entire list and, doubtless, in pursuance of the philosophy "as the metal goes so go the copper shares."

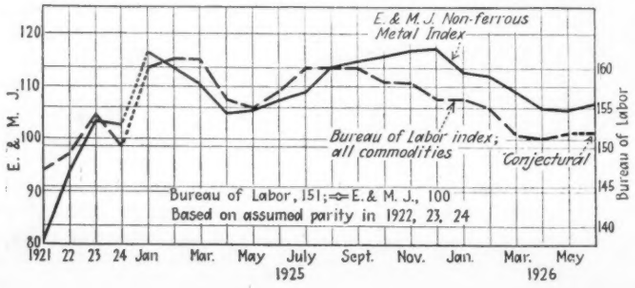
But the most decided improvement was in the "miscellaneous" group—the producers of gold, silver, lead, zinc, and, incidentally, copper. Hollinger, with its 4,920,000 shares, leads the list. Anticipaton of an increase in the dividend rate, predicated on increased capacity of the cyanide plant has helped Hollinger shares up 60c. to $19.85. Federal M. & S. apparently is recovering the ground lost as a consequence of the impounding of common dividends by court action; and its neighbor in Idaho, Hecla, is stronger because of the firmer lead market. Three other lead producers, Howe Sound, Silver King Coalition, and St. Joseph Lead, are among the stocks in this group that exhibited a marked bouyant tendency.

Whereas the statistics involving dollars and cents appear to be favorable, tonnage figures are not entirely reassuring, though the fact that they are somewhat stale by the time they can be compiled and issued tends to lessen their significance.

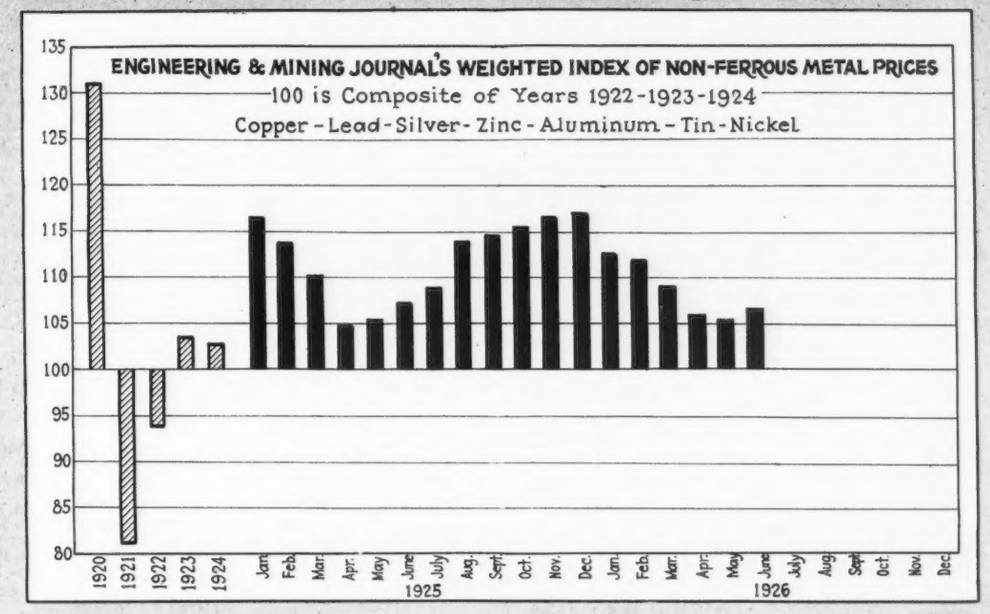
Stocks of all three of the major metals display an upward tendency, according to the latest available data. The production of refined copper declined sharply in May, but this was more than offset by increases in the supply of blister. Both domestic and foreign deliveries fell off in May following similar declines in April.

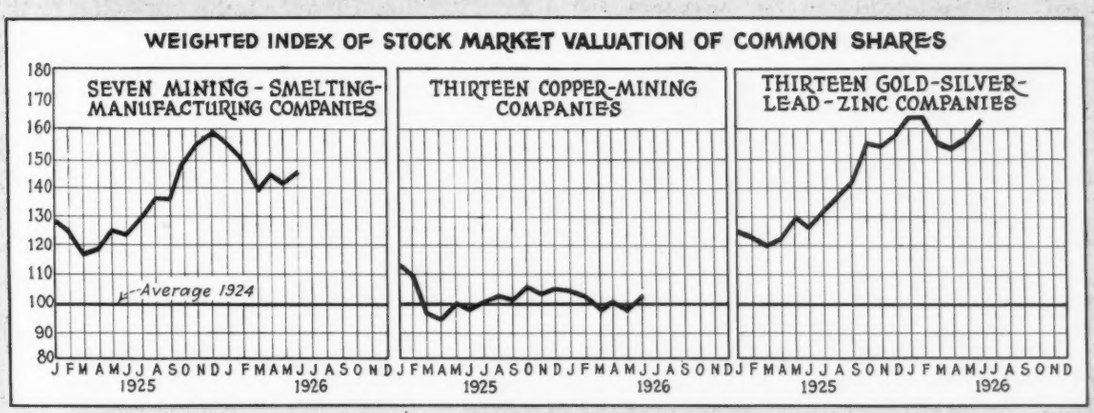
Stocks of zinc in the United States increased in May, whereas domestic deliveries and production showed little change. It is likely that June figures will show a decline in exports. The most noticeable feature in the statistics for lead is the increase in stocks; the other curves are fluctuating within narrow limits.

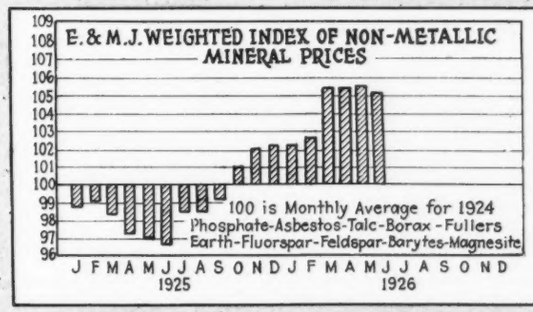
It should be emphasized, however, in regard to the increase in stocks, that these are comparatively low. For example, at the rate of 4,000 tons per day, 350,000 tons is only 90 days' production, and of this 350,000 tons only 70,000, or 17.5 days' production, is in the refined state. Zinc stocks of 30,000 tons represent only 17 days' production at the rate of 1,750 tons per day; and lead stocks of 120,000 tons could be replaced by United States and Mexican smelters in 53 days at the current rate of production. Here again only 14,000 tons is refined—or less than seven days' production. When viewed in this light the stocks of metal certainly are slim. Should output cease (which, of course, it will not), consumers would find themselves without any metal in a very brief time, particularly in view of the admitted paucity of the current supplies of raw material which are assumed to be in the hands of metal dealers and of the manufacturers themselves.

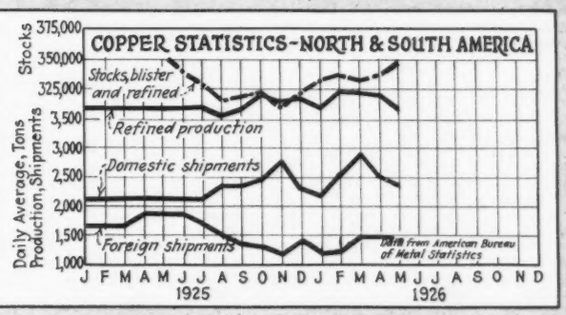


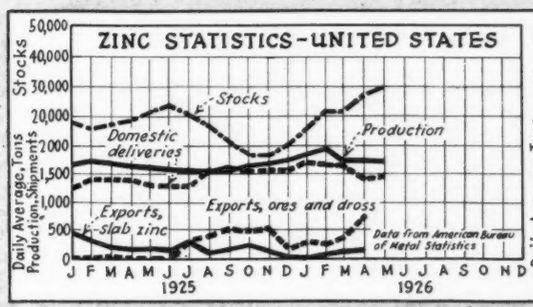
E.&M.J. Statistics of the Mining Industries

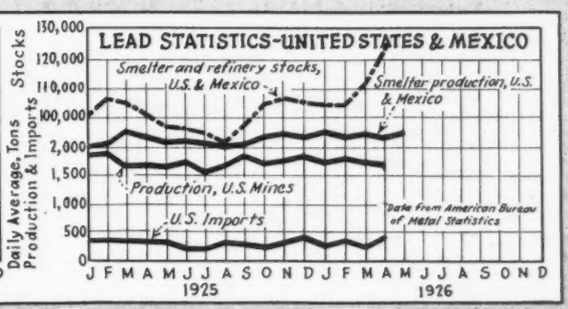

ENGINEERING & MINING JOURNAL'S WEIGHTED INDEX OF NON-FERROUS METAL PRICES
100 is Composite of Years 1922-1923-1924
Copper - Lead - Silver - Zinc - Aluminum - Tin - Nickel
1925
1926




E. & M.J. WEIGHTED INDEX OF NON-METALLIC MINERAL PRICES
100 is Monthly Average for 1924
Phosphate-Asbestos-Talc-Borax - Fullers Earth-Fluorspar-Feldspar-Barytes-Magnesite
1925
1926







Mining Stocks—Week Ended July 3, 1926

Stock	Exch.	High	Low	Last	Last Div.
COPPER					
Anaconda	New York	47½	46⅞	46⅞	Jy.17, Au.23 Q 0.75
Arcadian Consol.	Boston			*70	
Ariz. Com'l.	Boston	11	10½	11	Jy.21, Jy.31 SA 0.50
Calaveras	N. Y. Curb			1⅛	
Calumet & Arizona	New York	67⅞	65½	66½	Jn. 4, Jn. 21 Q 1.50
Calumet & Hecla	Boston	14½	14	14⅛	Jn. 1, Jn. 15 Q 0.50
Cerro de Pasco	New York	66	64⅛	65⅜	Jy. 15, Au.2, Q 1.00
Chile Copper	New York	33⅛	32⅞	33⅛	Jn.2, Jn.28, Q 0.62½
Chino	New York	22⅜	22⅛	22⅜	Sept., 1920 0.37½
Con. Coppermines	N. Y. Curb			3⅜	
Copper Range	Boston	15	14¼	14⅜	May, 1925 1.00
Crystal Copper	Boston Curb	*39	*33	*35	
East Butte	Boston	3	2⅞	2⅞	Dec., 1919 0.50
First National	Boston Curb	*16	*16	*16	Feb., 1919 0.15
Franklin	Boston			*40	
Granby Consol.	New York	21	20½	20⅜	May, 1919 1.25
Greene-Cananea	New York	16⅝	15½	15⅞	Nov., 1920 0.50
Hancock	Boston	*50	*50	*50	
Howe Sound	New York	38	37	37⅞	Ap.1, Ap.15 0.75
Inspiration Consl.	New York	23½	23	23½	Jn.7, Jy.6, Q 0.50
Iron Cap	Boston Curb	3½	3½	3⅝	Jn. 1, Jn. 15 0.50
Isle Royale	Boston	10½	10	10	Jn. 1, Jn. 15 0.50
Jerome Verde Dev.	N. Y. Curb	*51	*50	*50	
Kennecott	New York	55	53⅛	55	Jn. 4, July 1 Q 1.00
Lake Copper	Boston			*80	June, 1925 0.50
Magma Copper	New York	38½	37½	37⅝	Jn.30, July.15, Q 0.75
Mason Valley	N. Y. Curb	1⅝	1⅝	1⅝	
Mass Consolidated	Boston			*25	Nov., 1917 1.00
Miami Copper	New York	13½	13	13⅛	My.1, My.15 Q 0.25
Mohawk	Boston	33½	33	33⅛	My.1, Je.1 Q 1.00
Mother Lode Coa.	New York	6	5⅜	5⅜	Jn. 15, Jn. 30 0.37½
Nevada Consol.	New York	13⅜	13¼	13⅜	Jn. 15, Jn. 30 Q 0.25
New Cornelia	Boston	22½	20	22⅛	My.7, M.24 Q 0.40
North Butte	Boston	2⅝	2½	2½	Oct., 1918 0.25
Ohio Copper	N. Y. Curb	*61	*60	*61	No. 14, De. 2 0.05
Old Dominion	New York	16½	15½	16⅜	Dec., 1918 1.00
Phelps Dodge	Open Mar.	†124	†121		Jun.22, July2 Q 1.50
Quincy	Boston			19	Mar., 1920 1.00
Ray Consolidated	New York	14⅛	13⅜	14	Ap.20, Ap.30 0.25
Ray Hercules	N. Y. Curb			11⅞	
St. Mary's Min. Ld.	Boston	28⅜	27½	27⅛	Ap.17, My.18 2.00
Seneca Copper	New York			5⅞	
Shannon	Boston	*40	*35	*40	Nov., 1917 0.25
Superior & Boston	Boston			*75	
Tenn. C. & C.	New York	11⅞	11⅛	11⅜	My. 29 Ju.15, Q 0.25
United Verde Ex.	N. Y. Curb	28	27½	27½	Jy.17, Aug. 2, 0.75
Utah Copper	New York			100	Jn.15, Jn.31, Q 1.25
Utah Metal & T.	Boston	1⅜	1⅜	1⅜	Dec., 1917 0.30
Victoria	Boston			*41	
Walker Mining	Salt Lake	*20	*20	*20	
NICKEL-COPPER					
Internat. Nickel	New York	37	35½	37	Jn.30, Ju.15, Q 0.62½
Internat. Nickel, pfd.	New York			104	Ap.15, My.1, Q 1.50
LEAD					
Gladstone M. M. Co.	Spokane	*35⅛	*32	*32	Jn. 10, July10 0.1⅛
National Lead	New York	157	156	156	Jn. 11, Jn. 30 Q 2.00
National Lead pfd.	New York	116½	116½	116½	My.21, Je.15 Q 1.75
St. Joseph Lead	New York	42	40⅜	41⅞	Jn.10, Jn.21 QX 0.75
ZINC					
Am. Z. L. & S.	New York	7⅞	7⅜	7⅞	May., 1920 1.00
Am. Z. L. & S, pfd.	New York	33¼	31⅛	33	Nov., 1920 1.50
Butte C. & Z.	New York			5	De.10, De.24 0.50
Butte & Superior	New York	10⅜	9⅞	10	Jn.15, Jn.30 Q 0.50
Callahan Zn-Ld.	New York	1⅞	1⅝	1⅝	Dec., 1920 0.50
Eagle Picher	Cincinnati	30⅜	28½	30⅛	My. 15, Jn.1 0.40
Eagle Picher, pfd.	Cincinnati			110	Jn.30, Jy.15 Q 1.50
New Jersey Zn.	N. Y. Curb			208	Jn.9, Jy.10 Q 2.00
United Zinc	N. Y. Curb			*70	
Yellow Pine	Los Angeles	*25	*25	*25	De.8, De.18 Q 0.04
GOLD					
Alaska Juneau	New York	1½	1½	1½	
Argonaut	Toronto	*22	*20	*21½	
Barry-Hollinger	Toronto	*48½	*47	*47½	
Carson Hill	Boston			*30	
Consol. W. Dome L.	Toronto	*16	*14½	*15½	
Cresson Consol. G.	N. Y. Curb	2⅛	2	2⅛	Mh.31, Ap.10 0.10
Crown Reserve	Toronto	*10	*9	*9	Jan., 1917 0.05
Dome Mines	New York	13⅜	12⅜	12⅜	Jn.30, July 20, Q 0.50
Golden Center	N. Y. Curb	1⅜	1⅛	1⅛	
Golden Cycle	Colo. Springs	†1.49	†1.48		No.30, Dec.10 Q 0.03
Hollinger Consol.	Toronto	19.90	19.50	19.50	Jn.29, Jy.15 Q 0.10
Homestake Mining	New York	54½	54	54½	Jn.19, Jn.25 M 0.50
Kirkland Lake	Toronto	1.05	1.00	1.01	
Lake Shore	Toronto	11.35	11.15	11.15	Jn.1, Jn. 15 Q 0.10
McIntyre-Porcupine	New York	25	24⅞	24⅞	My.1, Jn.1 0.25
Newray	Toronto	*33	*33	*33	
Noranda	N. Y. Curb	15⅜	15	15	
Portland	Colo. Springs	†*48	†*45		July6, July15 0.02
Rand Mines	New York	37½	37½	37½	Fe.16, Fe.26 1.52
Teck-Hughes	Toronto	3.75	3.62	3.70	Ja. 15, Fe. 1 0.05
Tom Reed	Los Angeles	*62	*60	*60	Ma.10 Ma.20 0.02
Tough-Oakes	Toronto	*41½	*40	*40	
United Eastern	N. Y. Curb			*30	July, 1924 0.05
Vipond Cons.	Toronto	1.76	1.72	1.73	
Wright-Hargreaves	Toronto			8.45	Jn.15, Jy.1 QX 0.07½
Yukon-Alaska Trust	N. Y. Curb			21	
GOLD AND SILVER					
Carnegie Metals	Boston	15½	14⅜	14⅜	
Con. Cortez	N. Y. Curb			*6	
Con. Virginia	San Francisco	*4½	*4½	*4½	
Continental Mines	N. Y. Curb			*45	
Dolores Esperanza	N. Y. Curb			*39	July, 1923 0.05
Premier Gold	N. Y. Curb	2 5/16	2⅛	2⅛	Jn.18, Jy.3 Q 0.08
Tonopah Belmont	N. Y. Curb	3⅜	3 1/16	3 1/16	Se.15, Oc.1 0.05
Ponopah Extension	N. Y. Curb	*45	*45	*45	Apr., 1925 0.05
Tonopah Mining	N. Y. Curb	6⅜	6	6⅛	Ap.7, Ap.21 Q 0.07½
Unity Gold	N. Y. Curb			*20	
West End Consol.	N. Y. Curb			*16	Mar., 1923 0.05
Yukon Gold	N. Y. Curb			*30	June, 1918 0.02

Stock	Exch.	High	Low	Last	Last Div.
SILVER					
Alvarado	N. Y. Curb			1	Oct., 1920 0.50
Beaver Consol.	Toronto	*78	*75	*77	May. 1920 0.03
Castle-Trethewey	Toronto	1.48	1.43	1.47	
Coniagas	Toronto	3.70	3.65	3.65	May, 1924 0.12½
Keeley	Toronto	1.47	1.42	1.42	Ma.1, Ma.15 X 0.12
Kerr Lake	N. Y. Curb			1	Ap.1, Ap.15 0.12½
La Rose	Toronto	*12	*12	*12	Apr., 1922 0.10½
Lorrain Trout Lake	Toronto			*85	Jy. 2, Jy. 15 0.05
McKinley-Dar.-Sav.	Toronto	*16½	*15	*15	Oct., 1920 0.03
Mining Corp. Can.	Toronto	3.58	3.46	3.47	Jy.1, Jy.15 0.12½
Nipissing	N. Y. Curb	5⅜	5	5⅛	Jn.30, Jy.20 0.15
Temiskaming	Toronto	*11	*11	*11	Jan., 1920 0.40
SILVER-LEAD					
Ahumada	New York	8⅛	8	8	Jn.18, Jy.5, Q X 0.25
Alta Merger	Salt Lake	†*5½	†*2		
Bingham Mines	Boston	34⅞	34⅞	34⅞	Jn.19, Jn.30 Q 1.00
Cardiff M. & M.	Salt Lake			*50	De.16, No.18 0.10
Chief Consol.	Salt Lake	3.00	3.00	3.00	Ap.1, My.1 Q 0.10
Emma Silver	Salt Lake	†*75	†*50		
Erupcion	Boston Curb	1⅜	1⅜	1⅜	Jn.18, Jy.5, QX 0.10
Federal M. & S.	New York	70	69	70	
Federal M. & S., pfd.	New York	74½	72	74½	My.25, Ju.15 Q 1.75
Hawthorne Mines	N. Y. Curb	*20	*19	*19	
Hecla Mining	N. Y. Curb	17½	17½	17½	My.15, Je.15 Q 0.50
Iron King Mining	Salt Lake	*27	*27	*27	
Keystone Mining	Salt Lake	*25	*25	*25	Au.12, Au.26 0.07½
Lucky Jim	Spokane	*18½	*17	*17	
Mammoth Mining	Salt Lake			2.85	Mar.24, Apr. 1 0.10
Marsh Mines	Spokane	*3½	*2½	*2½	Se.15, Oc.1 0.1⁰
Park Utah	New York	6.15	6.00	6.10	Jn.15, Jy.1 Q 0.15
Prince Cons.	Salt Lake			1⅜	
Silver King Coal	Salt Lake	8.25	8.25	8.25	Jn. 21, July1, Q 0.25
Silversmith	Spokane	*47½	*44½	*46	Jn.30, Jy.10 Q 0.02
Tamarack-Custer	Spokane	*31	*28	*29	Sept., 1924 0.25
Tintic Standard	Salt Lake	12.75	12.75	12.75	Jn.16, Jn.26, 0 40
Utah-Apex	Boston	8	7⅛	7⅛	Jy. 3, Jy.15 Q 0.25
Western Utah Copper	N. Y. Curb			*8	
IRON					
Bethlehem Steel	New York	42⅜	40⅛	41⅞	July, 1924 1.25
Colorado Fuel & Iron	New York	44⅞	40½	44½	May, 1921 0.75
Gt. North'n Iron Ore	New York	21⅛	20⅛	20⅜	De. 4, De. 28, 0.75
Inland Steel	New York	42½	38⅛	42	My.10, Je.1 Q 0.75
Mesabi Iron	N. Y. Curb			1⅛	
Replogle Steel	New York	10⅞	9⅛	10⅛	
Republic I. & S.	New York	55⅜	51¼	55⅛	May, 1921 1.50
Republic I. & S. pfd.	New York			94½	Jn.15, July1, Q 1.75
Sloss-Sheffield S. & I.	New York	141½	132½	138½	Jn.10, Jn.21 Q 1.50
Sloss-Shef. S.&I. pfd.	New York	110	107	110	Jn.21, July.1, Q 1.75
U. S. Steel	New York	144½	137½	143⅞	Jn.2, Jn.29 Q 1.75
U. S. Steel pfd	New York	130	129	130	My.4, My.29, Q 1.75
Virginia I. C. & C.	New York	47¼	47½	47½	Jan., 1924 1.50
Virginia I.C.&C.pfd	New York			73	Jn.1, July 2, 2.50
ALUMINUM					
Alum.Co.of Amer.	N.Y.Curb Ind.	74	73	74	
Alum. Co. of Amer pf.	N.Y.Curb Ind.			99⅜	June 15, July 1, Q 0.01½
VANADIUM					
Vanadium Corp.	New York	37	35½	35⅜	My.1, My.15, Q 0.75
ASBESTOS					
Asbestos Corp., New	Montreal	22	20	20	De.31, Ja.15 Q 1.50
Asbestos Corp., pfd.	Montreal	77½	75½	76	Jy.1, Jy.15, Q 1.75
SULPHUR					
Freeport Texas	New York	33⅛	30½	33	Nov., 1919 1.00
Texas Gulf	New York	151⅜	140¼	150½	Jn.1, Jn. 15, Q 2.50
DIAMONDS					
De Beers Consol.	New York			35½	Ja.26, Fe.2 0.23
PLATINUM					
So. Am. Gold & P.	N. Y. Curb	5⅜	5	5⅛	
MINING, SMELTING, REFINING AND GENERAL					
Amer. Metal	New York	53	52⅛	52⅛	My.20, Je. 1, Q 1.00
Amer. Metal pfd.	New York	116½	115½	116½	My.20, Je. 1 Q 1.75
Amer. Sm. & Ref.	New York	133⅞	127⅞	133⅜	Jy.10, Au.2, Q 1.75
Amer. Sm.&Ref.pfd.	New York	117⅞	117⅛	117¼	Au.7, Se.1, Q 1.75
Consol. M. & S.	N. Y. Curb			208	Jn.30, Jy.5 QX 3.75
Federated Metals	N. Y. Curb			12½	
Newmont Mining	N. Y. Curb	61⅞	56⅞	61⅞	Mar.31, Apr.15, 0.60
Southwest Metals	N. Y. Curb			1	Jn.30, Jy.15 0.60
U. S. Sm. R. & M.	New York	41½	40⅛	40⅞	Jy. 7, Jy. 15, Q 0.87½
U. S. Sm. R.&M.pfd.	New York	50	49	50	Jy. 7, Jy. 15, Q 1.75

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Henry Sachs, Colorado Springs, Colo.

PRICE WEEK ENDED JUNE 22, 1926

Name	High	Low	Last	Last Divd. Date	Amount
Aramayo Mines (25 frs.)	81/3	77/6	78/9	May. 1926	5 p.c.†
British Platinum (£1)	6/6	5/3	6/—	Feb. 1925	2½ p.c.
Burma Corpn. (10 rupees)	16/3	15/6	15/9	Aug. 1926	6 annas*
Bwana M'Kubwa (5s)	8/—	7/6	7/7½		
Camp Bird (£1)	5/—	4/7½	5/—		
El Oro (£1)	6/6	5/7½	6/—	Nov. 1924	2½ p.c.*
Esperanza (10s)	1/1½	—/10½	1/1½		
Frontino & Bolivia (£1)	7/6	7/3	7/6	July 1926	2½ p.c.
Mexican Corpn. (£1)	16/10½	16/3	16/3	Dec. 1925	12½ p.c.*
Mexico Mines of El Oro (£1)	29/6	29/4½	29/4½	June 1926	7½ p.c.*
Oroville Dredging (£1)	3/10½	3/9	3/9	Dec. 1923	3¾ p.c.
Ouro Preto (£1)	2/1½	2/—	2/1½	May 1925	2½ p.c.
Rhodesian Congo Border	130/—	120/—	122/6		
St. John del Rey (£1)	10/1½	9/6	9/9	June 1925	6¼ p.c.
San Francisco Mines (10s)	29/3	28/3	29/—	June 1926	22½ p.c.
Santa Gertrudis (£1)	20/9	20/—	20/3	July 1926	5 p.c.
Selukwe (2s. 6d.)	12/3	10/9	12/3	April 1917	6¼ p.c.
S. Amer. Copper (2s.)	4/6	4/3	4/6	Nov. 1917	75 p.c.
Tanganyika (£1)	41/10½	36/6	40/7½	Sept. 1925	5 p.c.
Tomboy (£1)	3/9	3/6	3/9	Jan. 1926	5 p.c.
Union Miniere du Haut-Katanga (Brussels)	7.400	6.925	7.190	July 1925	150 frs.‡

* Free of British income tax. † Swiss frs. ‡ Belgian frs.